THE DIGITAL COMPUTER AS AN AUTOMATIC TEACHING DEVICE

PETER D. STOGIS

THE DIGITAL COMPUTER AS AN AUTOMATIC TEACHING DEVICE

******

Peter D. Stogis

THE DIGITAL COMPUTER AS AN AUTOMATIC TEACHING DEVICE

by

Peter D. Stogis

Lieutenant, United States Navy

Submitted in partial fulfillment of
the requirement for the degree of

MASTER OF SCIENCE

IN

ENGINEERING ELECTRONICS

United States Naval Postgraduate School
Monterey, California

1965

THE DIGITAL COMPUTER AS AN AUTOMATIC TEACHING DEVICE

by

Peter D. Stogis

This work is accepted as fulfilling
the thesis requirement for the degree of
MASTER OF SCIENCE
IN
ENGINEERING ELECTRONICS
from the
United States Naval Postgraduate School

ABSTRACT

One way in which the computer can be used in a teaching situation is by making available to the instructor a computer language which permits him to prepare course material according to the precepts of programmed instruction. The computer then administers the course to the student in the manner prescribed by the instructor. This method is developed using a typewriter as the computer input-output device. The potential role of computer assisted instruction is also discussed.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1. Introduction.

It is generally accepted in the educational community that there is now, and there will be in the future, an increasing shortage of qualified instructors and educational facilities at all levels.

To alleviate these problems, attempts are being made to develop more efficient educational processes. Amongst the physical aids to instruction which have already been introduced are slides, movies, books, models, mock-ups and closed-circuit and broadcast educational television. More lately, programmed texts and computer assisted instruction have been added.

Programmed instruction is founded on the results of psychological research into the human learning process. Basically, it is suggested by this research that small segments of information should be presented, followed by questions which the student must successfully answer before proceeding. Many textbooks such as Encyclopedia Britannica's TEMAC series have adopted this technique.

Some experimentation has been conducted using electronic digital computers as the device to exploit the philosophy of programmed instruction [1,4,7,10,11]. The computer's speed permits considerable analysis of the student's responses so that he may be routed through the course of instruction in the manner most suited to his individual capabilities. The computer can be used at the same time to tabulate and analyze the student's responses. This tabulation can assist the instructor in evaluating the effectiveness of his course and the abilities of individual students and groups of students.

In the interest of economy, the computer could be time-shared between several students and/or instructors and could also be used for non-instructional tasks.

The purpose of this paper is to discuss the programming of a computer for use as a teaching device and to analyze its potential.

2. Essential Characteristics of Programmed Instruction.

Programmed instruction as envisioned by psychologists differs from conventional methods in that it programs the learning process through which an individual must pass to acquire specific knowledge [14]. It does this by presenting discrete increments of carefully ordered information to the student and by requiring his comprehension of each increment before continuing. It has the further advantage of providing the student with immediate feedback concerning the correctness of each of his responses. This permits self pacing and tends to produce a lower error rate.

To be of value, programmed instruction must either assist the instructor in his normal task and/or replace some of his efforts by a procedure which is at least as effective as his normal teaching processes. Since face to face contact is not a characteristic of programmed instruction, some tools, such as personal observation, will not be available to the instructor. On the other hand, some teaching techniques can be implemented very effectively.

The important psychological principles behind the learning process are [2] :

a. Participation. The more actively a student participates in a learning experience, the more attentive and motivated he is, the more he retains, and the more effective is the experience.

b. Reward. Students learn best when their efforts are rewarded.

c. Immediacy of reinforcement. The more immediate the acknowledgment, reward and/or correction, the more effective is the learning.

d. Knowledge of results. Students learn best when they know whether their response to a question is right or wrong.

e. Individual difference. The closer the learning situation matches each individual's needs, capacity, and capability, the more effective is the learning.

Before computer programs (software) can be written, these principles must be further catagorized in relation to the mechanics of their application. The software must allow the author to present or provide:

a. Reading assignments or textual material.

b. Questions.

c. Timely requests for student responses.

d. Anticipated correct or incorrect answers to be compared with student responses.

e. Comments for anticipated and unanticipated student responses.

f. Branching through basic and remedial course material in a sequence which can be conditioned by the student's performance.

3. Equipment.

The Control Data Corporation (CDC) model 160 computer was used for this project. It is a small general purpose computer having 4096 12-bit words of core storage and a 6.4 usec cycle time. A CDC model 163 magnetic tape unit has been used for additional storage. The United States Naval Postgraduate School installation has available a CDC model 161 typewriter and a Data Display Corporation model 65 display unit for use as man/machine interaction devices. The typewriter was selected because of its relative ease of programming and its immediate location to the computer.

4. Application of the Computer to Programmed Instruction.

In section 2, the tasks which the instructor wishes to have performed by the programmed teaching device were listed. Shorthand notations (pseudo operation codes) are now assigned to these tasks so that the computer program can recognize the instructor's intentions (Table 1).

The author's course segments then become the arguments of the pseudo operation codes. Briefly, the author might supply a reading assignment (rd), then a question (qu), followed by anticipated correct answers (ca and cb) and anticipated wrong answers (wa and wb). Interspersed amongst the above may be comments the instructor desires to deliver for anticipated and unanticipated student responses (ty and un). Labeling and branching information are also supplied by the instructor to control the flow of course material to the student. A simple example is shown in Figure 1.

Editing procedures are provided to permit the instructor to revise his course as required.

The instructor is free to write his course in a manner commensurate with his imagination and ingenuity; however, because hardware is an integral part of the system, certain rules of procedure and format are necessary. The computer program has been written so that these rules are few in number and as simple as possible. Detailed operating instructions for the writing of a course will be found in Appendix II.

TABLE 1.

PSEUDO OPERATION CODES FOR USE BY THE INSTRUCTOR

Op code	Argument description
rd	A reading assignment, textual material or general comment.
qu	A question to be presented to the student.
ca	The best correct answer of a set of correct answers.
cb	Secondary correct answers of the same set.
wa	The first wrong answer of a set of wrong answers.
wb	Secondary wrong answers of the same set.
ty	A comment to be presented if the student responded with an argument of a ca, cb, cb..... set or a wa, wb, wb..... set.
un	A comment to be presented if the student response does not match any of the supplied answers.
br	A jump instruction.

```
first

        rd                    SAMPLE COURSE
           Read Section 4.1 of the course text "Modern Algebra."

        qu Solve the following equations for x:

                        x + y = 2

                        x - y = 4

        ca 3

        cb 3.0

        ty Correct

        br second

        wa -1

        wb -1.0

        ty You have solved for y.  Try again.

        un Check your typing and try again.

        br 1st help

1st help

        qu To solve for x, it is necessary to reduce the two equa-
tions in two unknowns to one equation in x.  The simplest way to per-
form this operation is by adding the two equations.  Now, what is
the value for x?

        ca 3

        cb 3.0

        ty Correct

        br second

        un The correct answer is        x + y = 2
                                    +   x - y = 4
                                       2x     = 6
                                            x = 3

second ..................,
```

Figure 1. The use of pseudo operation codes by the instructor.

A separate mode of operation is provided for the student. In this mode the computer administers the author's course to the student. The sample course of Figure 1 could unfold in a different manner to different students as indicated, for example, in Figures 2 and 3. The student may also ask for help in which case the computer responds with the correct answer (ca).

Student responses are recorded to permit grading and the analysis of course effectiveness.

Operating instructions for the student are described in Appendix III.

The course material may be entered into the system by a typist or by the instructor himself. In the latter case, the instructor can change his role from professor to student in order to check the instructional mode of operation.

first

SAMPLE COURSE

Read Section 4.1 of the course text "Modern Algebra."

(Student signals completion of the reading assignment)

Solve the following equations for x:

$$x + y = 2$$

$$x - y = 4$$

3

Correct

second .....

Figure 2. The result of student A's enrollment in the sample course of Figure 1.

first

SAMPLE COURSE

Read Section 4.1 of the course text "Modern Algebra."

(Student signals completion of the reading assignment)

Solve the following equations for x:

$$x + y = 2$$

$$x - y = 4$$

4

Check your typing and try again.

4

To solve for x, it is necessary to reduce the two equations in two unknowns to one equation in x. The simplest way to perform this operation is by adding the two equations. Now, what is the value for x?

-1

The correct answer is

$$\begin{array}{rr} & x + y = 2 \\ + & x - y = 4 \\ \hline & 2x \quad = 6 \\ & x = 3 \end{array}$$

second.....

Figure 3. The result of student B's enrollment in the sample course of Figure 1.

5. System test.

After the programming was completed, a small test course was entered and several "students" were enrolled. It was then possible to test the system for proper functioning. No attempt was made to evaluate the effectiveness of this system in an actual teaching environment.

6. Conclusions.

The Control Data model 160 computer used in this project proved adequate for this application. However, because of the computer program occupied two-thirds of memory, a slight problem developed in the manipulation of course material (Appendix IV). In addition, a computer used in an actual teaching installation should have indexing and memory test instructions in its machine language repertoire for more efficient operation.

It was clear from the beginning that magnetic tape is not a satisfactory medium for intermediate storage. Its serial method of recording required inefficient software techniques and could lead to delays in operation. Both of these problems could be rectified by the use of random access disk files or drums.

The typewriter is considered only moderately effective as an interaction device. Average reading speeds greatly exceed the output speed of any typewriter and the generation of the symbol notation used in some fields can be difficult or even impossible. For example, the manipulations required to type a definite integral ($\int_a^b f(x)\,dx$), especially from the standpoint of the student, reduce the effectiveness of the man/machine communication.

A device considered more suitable for this application is a cathode ray tube/keyboard combination such as the Data Display Corporation model 65. Textual material could then be presented essentially instantaneously and modification of the character set or type format will generally be more feasible.

Industry is currently developing new devices such as the Rand Tablet [13] which will allow handwritten communication with the computer. These devices would greatly increase the potential of computer assisted instruction.

The pseudo operation codes, listed in Table 1, were sufficient for the course tested; however, a need is recognized for the expansion of the branching code. Situations are anticipated when the instructor may wish to make his branches depend upon the student's performance, as might be measured by the number of help requests, the number of attempts to answer a question or the time taken to respond. The software could easily be expanded to include these facilities.

To fully exploit new ideas in teaching techniques, it might also be desirable to provide means for the instructor to change the software logic. This, however, would make it necessary for the instructor to acquire a knowledge of computer programming.

There has been a suggestion that statistical decision theory could be used to automatically adapt a course to a student's learning characteristic [8]. This represents a rather revolutionary concept but typifies the ideas that are expected to be germinated by the presence of a computer in an educational environment.

Programmed instruction, especially when computer assisted, appears to require a more precise approach to instruction than is the case in conventional circumstances. In the classroom, a teacher can react to each new situation as it arises, but here he must anticipate the student reaction to course material. Of course, the instructor could just

observe the tabulation of student responses and revise his course as required, but it may take some time to acquire a satisfactory sample size. In the meantime, the earlier students would suffer. The new thought patterns required are not considered to present an overwhelming burden to an experienced instructor, but he must anticipate that the preparation of course material will be very slow. This apparent disadvantage is balanced by the fact that the material, once prepared, can be used repeatedly. Several publications are available to assist the instructor in the preparation of programmed instruction [9, 10, 12, 14].

There is, currently, one other aspect of computer assisted instruction which may cause difficulty. When questions require lengthy answers, there are usually many different, but correct, ways in which the answer can be expressed. The computer program would have no difficulty in checking the answers, but the instructor would be hard pressed to supply all possible correct answers. These remarks also apply to plurals, contractions, punctuation, etc. For this reason computer assisted instruction is likely to be more easily applied in the fields of the exact sciences.

At this point, it might be well to point out that the software has been developed with the prerequisite that communication with the computer should be as effortless as possible or, in other words, that the instructor should be isolated from computer programming. To realize this goal a rather complex system program is necessary and it is estimated that a complete system would require in the order of one man year to develop.

Not yet mentioned is the question of cost. Although several organizations have been experimenting with computer assisted instruction, no industrial firm has yet reached a stage of development that would permit cost analysis. At the moment, it is not even clear if it would be more economical for a computer assisted instruction system to be set up with its own small computer or whether it should share part of the operating time of a large computer system. Other important factors include: the potential for reducing the class contact time of the instructor, student usage, and the time required to write a course. The high cost of computers would seem to indicate a high cost of operation; however, it is suspected that a well designed system when optimized in relation to modern hardware technology and the other factors mentioned above could produce a very reasonable cost per student hour.

There has been some effort to compare the effectiveness of computer assisted instruction with classroom instruction [2,5]. Although this author feels that the sample size in many cases was too small to be decidedly conclusive, these studies indicate a slight advantage to computer assisted instruction. The system discussed in this paper was not used in an actual teaching situation; however, feedback to the student was found to be extremely fast---so much so that, at times, it was disconcerting. This by itself is not conclusive since the quality of the feedback is still determined by the instructor; however, it does indicate that computer time is available to incorporate other desirable features as discussed earlier in this section.

Computer assisted instruction is viewed as a potentially powerful addition to the teaching art.

7. Acknowledgments.

The author is indebted to Professor John R. Ward for his constructively critical review of this manuscript and to the Computer Facility of the U.S. Naval Postgraduate School for their cooperation in providing the equipment necessary for this project.

8. Bibliography

1. Annetl, J. Teaching Machines, Discovery, Vol. 22-5, May, 1961: 191-198.

2. Quackenbush, J. How Effective Are the New Auto-Instructional Materials and Devices?, IRE Transactions on Education, Vol. E4, Dec., 1961: 144-151.*

3. Cron, R. L. Why Automate Instruction?, IRE Transactions on Education, Vol. E4, Dec., 1961: 132-134.

4. Braunfeld, P. G., Bitzer, D., and Lichtenberger, W. PLATO: An Automatic Teaching Device, IRE Transactions on Education, Vol. E4, Dec., 1961: 157-161.

5. Coulson, J. E. Programmed Learning and Computer-Based Instruction, John Wiley and Sons, Inc., New York, 1962.*

6. Busnell, D. D. Computers in the Classroom, Data Processing, Vol. 4 No. 4, April, 1962: 9-14.

7. Braunfeld, P. G., and Postdick, L. D. The Use of an Automatic Computer System in Teaching, IRE Transactions on Education, Vol. E6, Sept./Dec., 1962: 156-167.

8. Smallwood, R. D. A Decision Structure for Teaching Machines, M.I.T. Press, Cambridge, Mass., 1962.

9. Moore, R. K. Programmed Instruction---The Engineering of Educa- IRE Transactions of Education, Vol. E6, Dec., 1963: 60-64.

10. Schure, A. The Impact of Programmed Self-Instruction on Scheduling and Other Logistical Administrative Problems, IRE Transactions on Education, Vol. E6, Dec., 1963: 65-71.

11. IBM. IBM 1401 or 1440 Computer Assisted Instruction, 1964, et seq.

12. Uhr, L. Compilation of Natural Language Text Into Teaching Machine Programs, AFIP Proceedings - Fall Joint Computer Conference, 1964: 35-44.

13. Davis, M. R. The Rand Tablet: A Man-Machine Graphical Communication Device, AFIPS Proceedings - Fall Joint Computer Conference, 1964: 325-331.

14. Murphy, J. R. and Goldberg, I. A. Stratgies for Using Programmed Instruction, Harvard Business Review, May, 1964: 115-132.

*These references also contain extensive bibliographies.

APPENDIX I

EQUIPMENT OPERATION

1. Computer

The program is loaded at program address 0000. Run the program from program address 0000.

2. Tape unit

The course tape is loaded on the CDC 163, which is set to unit 1 and coded parity.

3. Typewriter

Check power on, disconnect switch to AUTO, and the control switch to COMPUTER. Set the first tab stop 10 spaces in from the left margin.

At the start, the computer will request the administrative information described in Appendix II. When the instructor mode is indicated, the computer drives the typewriter to the first tab and types a colon. A carriage return at this juncture indicates that a label or special author function is to follow. If a carriage return is not hit, the computer expects a legal pseudo operation code to follow.

Two double character codes are accepted. A double period signifies an "end of block." A double comma in the instructor mode orders the computer to erase the present line. A restart occurs where the line began before the erase call. In the student mode, the erase code is a carriage return or a double comma.

APPENDIX II

OPERATING INSTRUCTIONS FOR THE WRITING OF A COURSE

The complete list of pseudo operation codes is shown in Table 2.

Rules of format are as follows:

a. Labels and the op-codes FINIS, STUD and PROF are always written at the left hand margin.

b. All other operation codes are written at the first tab as indicated automatically by the computer.

c. Second and successive lines of an argument may start anywhere and there is no limit set on the length.

d. The termination of labels and the arguments of the pseudo operation codes is signaled by the end of block (EOB) code. The computer will respond with a carriage return.

Rules of procedure are as follows:

a. A reading assignment must be followed by another reading assignment or by a question.

b. A question must be followed by a correct answer (ca), a comment (ty), or a branch (br).

c. A label or the argument of a branch must be ten characters, or less, in length. If more than ten characters are written, the computer will accept only the first ten.

d. The operation codes "ca" and "cb" are part of a set as are "wa" and "wb". This allows the instructor to initiate the same comment (ty) or branch for a number of student responses.

e. Comments for unanticipated student responses (un) are listed at the end of a course block -- just before a new label -- but may be followed by a branch.

The instructor is then free to use the operation codes as he pleases; however, there are two features of the student mode which the instructor will have to keep in mind. When a "ca" or "cb" operation code is successfully executed, the program will proceed to the next "rd" or "qu", after typing any "ty" arguments associated with the "ca" - "cb" group. This action may be modified by the use of a branch. When a "wa", "wb" or "un" operation code is successfully executed, the computer will wait for another student response to the present question after typing any "ty" arguments. In other words, the program loops back to the "ca" following the present question. Again a branch will modify this procedure and if a branch is not supplied after the last "un" argument, further unanticipated responses will cause a loop condition until a correct answer is finally given.

A sample course as actually entered into the computer is shown in Figure 4.

The computer will output comments to the operator at certain times. These messages are listed in Table 3. Unfortunately, the computer cannot anticipate the instructor's intentions and some course error messages will appear only in the student mode; therefore, it is recommended that the instructor assume the role of a student to check his course.

TABLE 2

PSEUDO OPERATION CODES

Op code	Argument description
rd	A reading assignment, textual material or general comment.
qu	A question to be presented to the student.
ca	The best correct answer of a set of correct answers. This could be the only member of the set.
cb	Secondary correct answers of the same set.
wa	The first wrong answer of a set of wrong answers. This could be the only member of the set.
wb	Secondary wrong answers of the same set.
ty	A comment to be presented if the student responded with an argument of a ca, cb, cb.... set or a wa, wb, wb..... set.
un	A comment to be presented if the student response does not match any of the supplied answers.
br	A jump instruction.

SPECIAL FUNCTION CODES

Label field	Description
Instructor codes	
FINIS	This code signals the completion of the segment of the course the instructor wishes to write at one sitting.
STUD	This code will switch the instructor into the student mode.
PROF	This code will switch the instructor back into his own mode and is used only after the use of STUD.

Student codes

GO TO XXXX The XXXX is a four digit label identifier obtained from the course index. This statement is used by a student when he desires to go to a different course area.

HELP When typed instead of a normal response, the computer gives the correct answer to the current question.

STOP Indicates the student desires to terminate his instruction.

TABLE 3

DESCRIPTION OF COMPUTER MESSAGES TO AN OPERATOR

Message	Description and action required.
TYPE S FOR STUDENT OR P FOR PROF	This is the first message typed after the initial start and sets the mode of operation.
TYPE O FOR OLD OR N FOR NEW	Used in the instruction mode, this action informs the computer that course is being continued or a new course will be written.
TYPE LAST NAME	A request for the identity of the student.
TYPE DESIRED 4 DIGIT START NUMBER	Allows student to choose his starting point.
ERROR IN OP CODE. TRY AGAIN.	The author has used an illegal op code.
NO CR BEFORE EOB. TRY AGAIN.	A carriage return is not allowed before the EOB code when typing a label or the argument to a branch code.
DUPLICATE LABEL. TRY AGAIN.	Duplicate labels are not accepted.
YOUR LAST COURSE RECORD IS:	When an old course is being continued, the last course block is typed out to the instructor. This heading precedes the type out.
Line erased.	Informs the operator that the computer has accepted the erase call.
THE CORRECT ANSWER IS:	Given when the student has requested help.
COURSE ERROR. INSTRUCTIONS TERMINATED.	Typed out when the computer has found an unreasolvable conflict.

```
TYPE S FOR STUDENT OR P FOR PROF.
p
TYPE O FOR OLD OR N FOR NEW
n
                :
first..
                :rd                          SAMPLE COURSE
                     Read Section 4.1 of the course text "Modern Algebra."
..
                :qu Solve the following equations for x:

                                    x + y = 2
                                    x- y = 4
..
                :ca 3..
                :cb 3.0..
                :ty Correct. ..
                :br  second..
                :wa -1..
                :wb -1.0..
                :ty You have solved for y.  Try again. ..
                :un Check your typing and try again. ..
                :br  1st help..
                :
1st help..
                :qu To solve for x, it is necessary to reduce the two
equations in two unknowns to one equation in x.  The simplest way to
perform this operation is by adding the two equations.  Now, what is
the value for x?..
                :cx
ERROR IN OP CODE.  TRY AGAIN.
                :ca 3..
                :cb 3.0..
                :ty Correct. ..
                :br  second..
                :un The correct answer is:
                                                    x + y = 2
                                                +   x - y = 4
                                                    ------
                                                    2c,,
Line erased.

                                                  2x     = 6
                                                       x = 3..
                :
second..
                :qu (more course would be added here)  WE will insert
some random material. ..
                :ca 546..
                :ty You are correct. ..
                :ty This exercise is continued on the next page.  ..
```

Figure 4. A sample course as entered into the computer. (Page 1 of 2)

```
              :un You have given an answer which is not logical.
Try again. ..
              :br  third..
              :
stud..              (Here the author wishes to check his course )
TYPE DESIRED 4 DIGIT START NUMBER

0001..
 first            0001
                                        SAMPLE COURSE
                    Read Section 4.1 of the course text Modern Algebra.

..
               Solve the following equations for x:

                                    x + y = 2
                                    x- y = 4

4..
              Check your typing and try again.
-1..
               You have solved for y.  Try again.
help..

THE CORRECT ANSWER IS
 3
3..
               Correct.

 second           0002
 (more course would be added here)  WE will insert
 some random material.
547..
              You have given an answer which is not logical.
Try again.
prof..              (Here the author returns to writing his course)

YOUR LAST COURSE RECORD IS:
 second           0002
              qu (more course would be added here)  WE will insert
 some random material.
              ca 546
              ty You are correct.
              ty This exercise is continued on the next page.
              un You have given an answer which is not logical.
Try again.
              br  third        0004

              :
finis..
TYPE S FOR STUDENT OR P FOR PROF.
```

Figure 4. A sample course as entered into the computer. (Page 2 of 2)

APPENDIX III

OPERATING INSTRUCTIONS FOR A STUDENT

At the start, the computer will request the student's name. The student enters his name on the typewriter and types an EOB. The computer will then generate the following message: "TYPE 4 DIGIT START NUMBER." This number (greater than 0000) refers to the label identifier listed in the course index. After being informed of the desired starting point, the computer will go there and start the course of instruction.

Anytime the typewriter is positioned at the left hand margin and the INPUT light is on, the computer is waiting for a response from the student. In the case of a reading assignment, textual material or general comment just preceding, the proper response is an EOB code. In all other cases the student should type his answer followed by an EOB code.

Several special codes may be used instead of a normal response. "HELP" will signal the computer to produce the correct answer to the question. After the correct answer has been typed out the computer will wait for the student to type back the answer exactly as it was given. If the student desires to skip or return to a given course area he types "GO TO XXXX". XXXX is the same number described in the first paragraph. The code word "STOP" will terminate instruction. All special codes must be followed by an EOB.

If the student makes a typing error, a carriage return will signal a erase code.

Refer to Table 3, Appendix II for error messages.

APPENDIX IV

SOFTWARE SPECIFICATIONS

All information processing is performed in BCD code. All characters are handled in packed form --- two BCD characters per computer word.

Course information is recorded on magnetic tape in 100 BCD character record lengths. A typewriter line comprises one record. The line is transferred to tape when a carriage return key is hit.

A course block is considered to be that section of course material between labels but including the identifying label. An end-of-file mark is written on the tape just before a new label. Course material is read into the computer memory by course blocks. The present program length restricts course block lengths to a maximum of 42 typewriter lines.

Only 54 of the 64 possible octal codes are utilized for character representation. Six of the remaining codes were used to identify special course and typewriter functions as follows:

Tab	51	Carriage Return	55
Backspace	56	Upper Case	16
Lower Case	76	End of Block	36

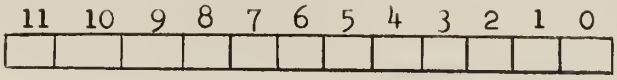
The computer ignores spaces in the arguments of the codes "ca", "cb", "wa", and "wb" and in the student's response.

In the instructor mode, the software generates a symbol table to store information regarding labels and the branch arguments. Each entry in the symbol table occupies six computer words and its bit structure is depicted in Figure 5. This symbol table is located at the end of a course tape. It is read in when the instructor mode

is called and is dumped to tape when the instructor mode is terminated by the label "FINIS". Figure 6 depicts the magnetic tape layout.

The flow diagrams are shown in Figures 7, 8 and 9.

The computer listing is contained in Appendix V. Definitions of significant symbolic addresses are given in Appendix VI and a cross reference table for the listing will be found in Appendix VII.



Word	Bit	Use
1	11	A "1" indicates the symbol is used as a label.
	10	A "1" indicates the symbol is used as a branch.
	9	Not used.
	8-0	A three digit octal reference number assigned to the symbol.
2-6		Symbol characters packed two per word.

Figure 5. Bit structure of a entry in the symbol table.

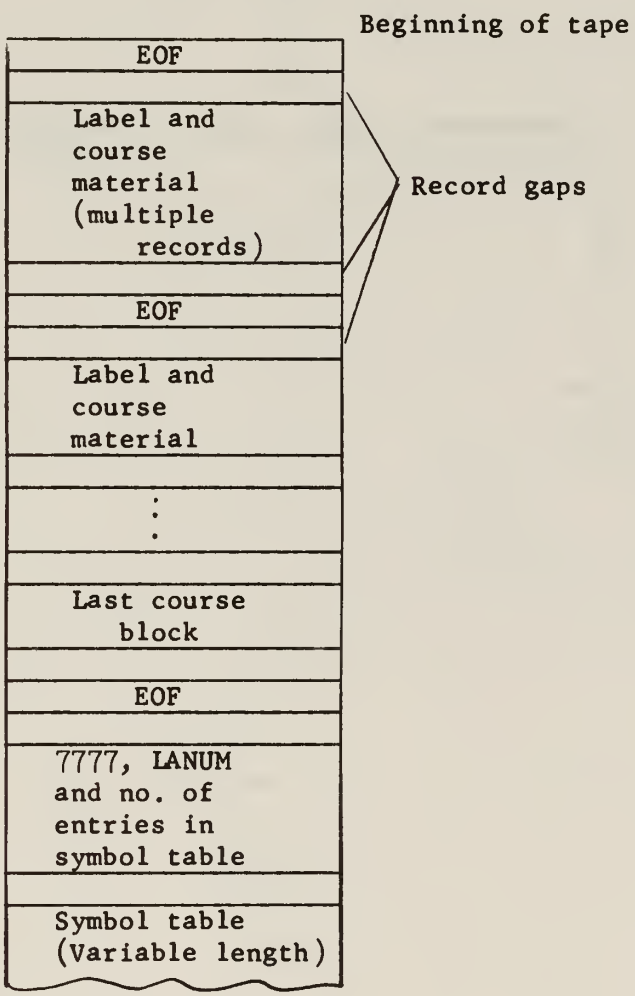


Figure 6. Magnetic tape layout.

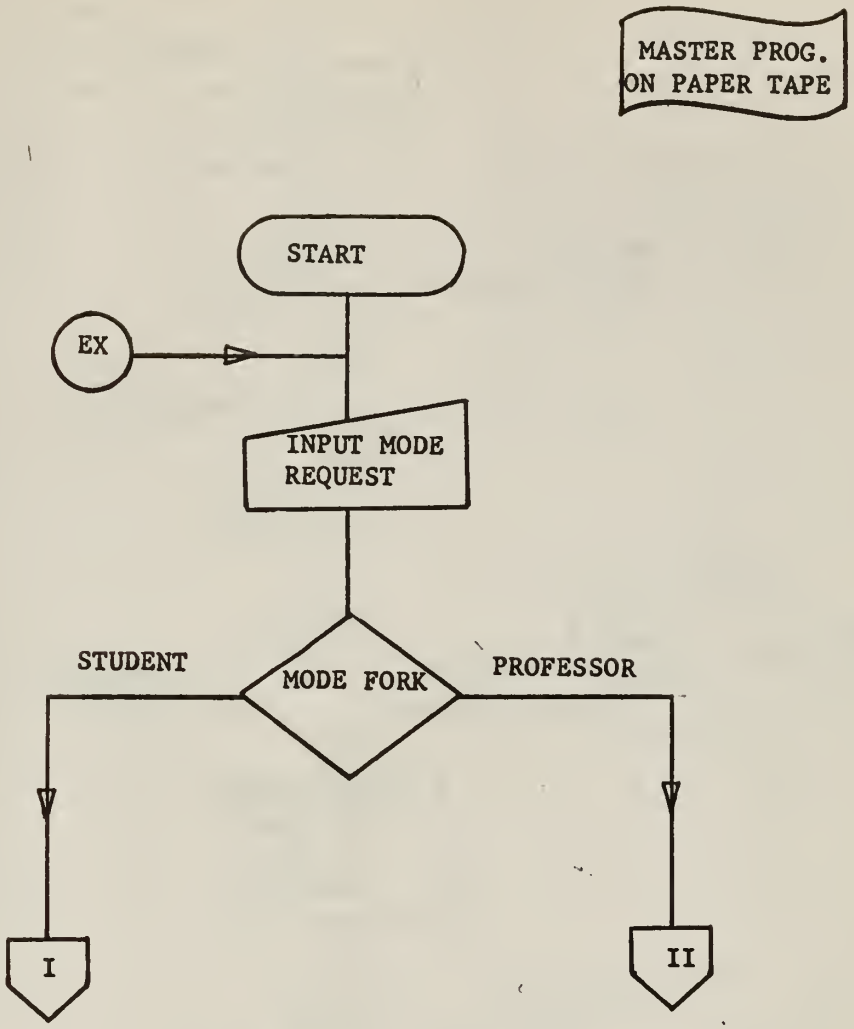


Figure 7. System Flow Diagram - Mode Control.

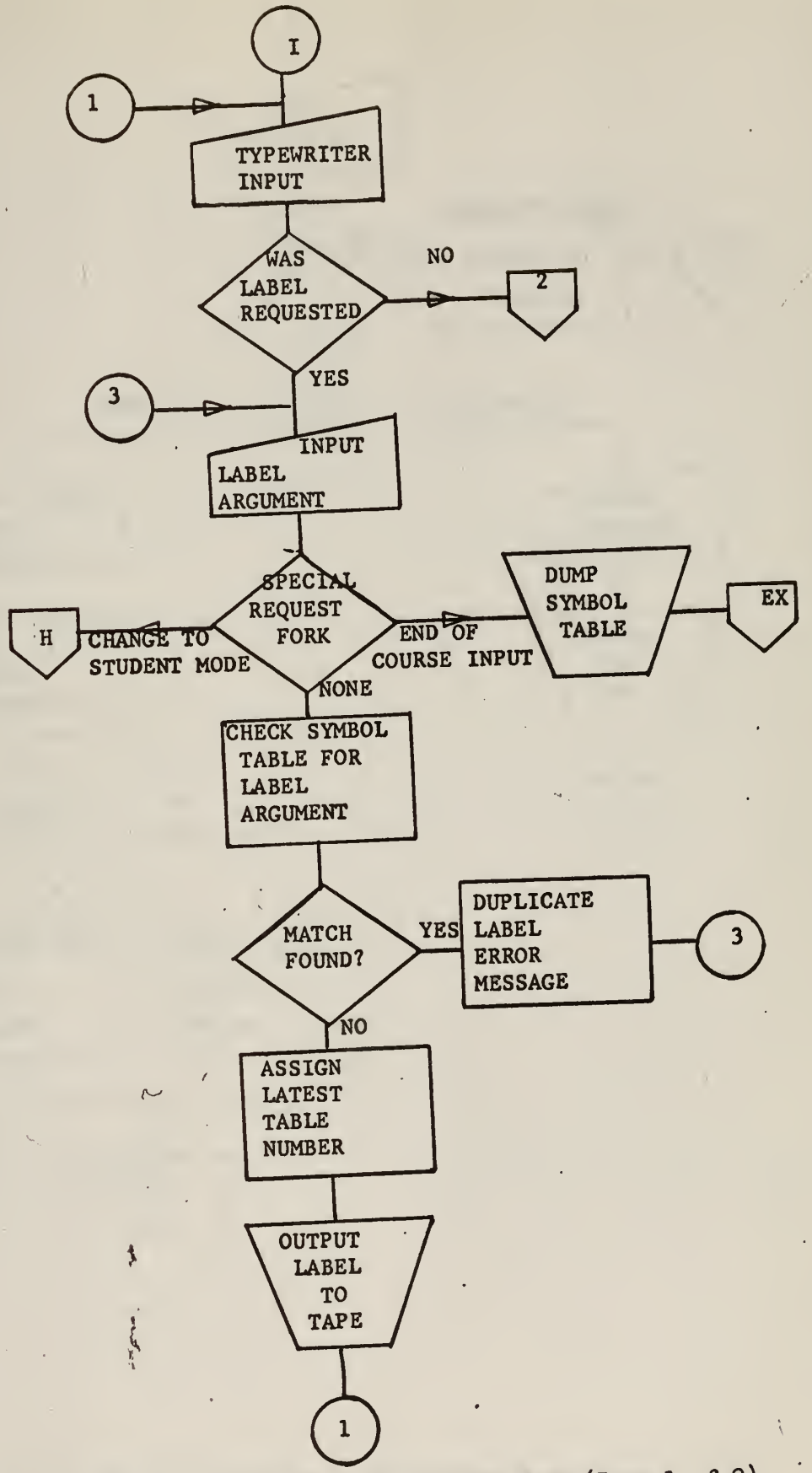


Figure 8. System Flow Diagram - Instructor Mode (Page 1 of 2)

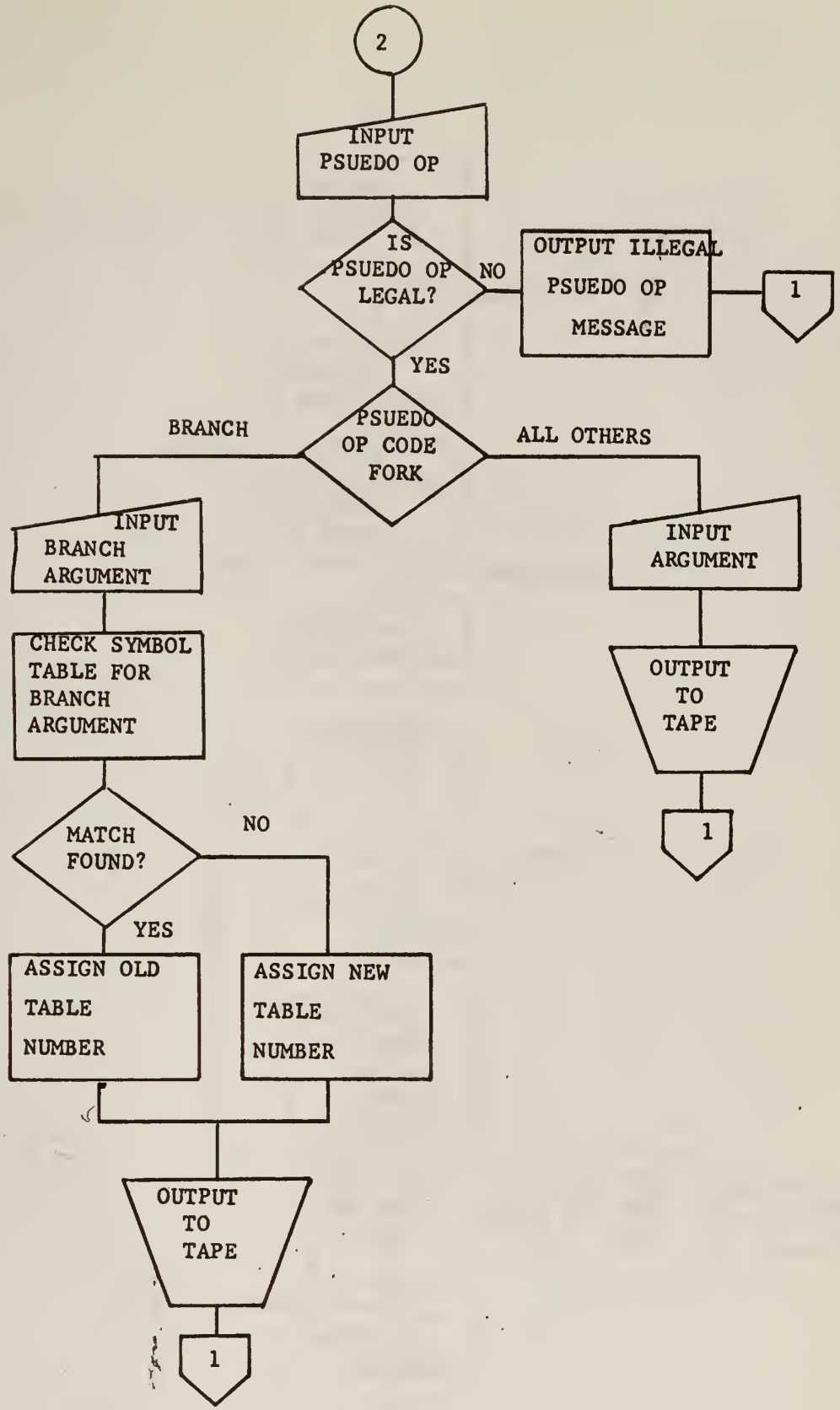


Figure 8. System Flow Diagram - Instructor Mode (Page 2 of 2)

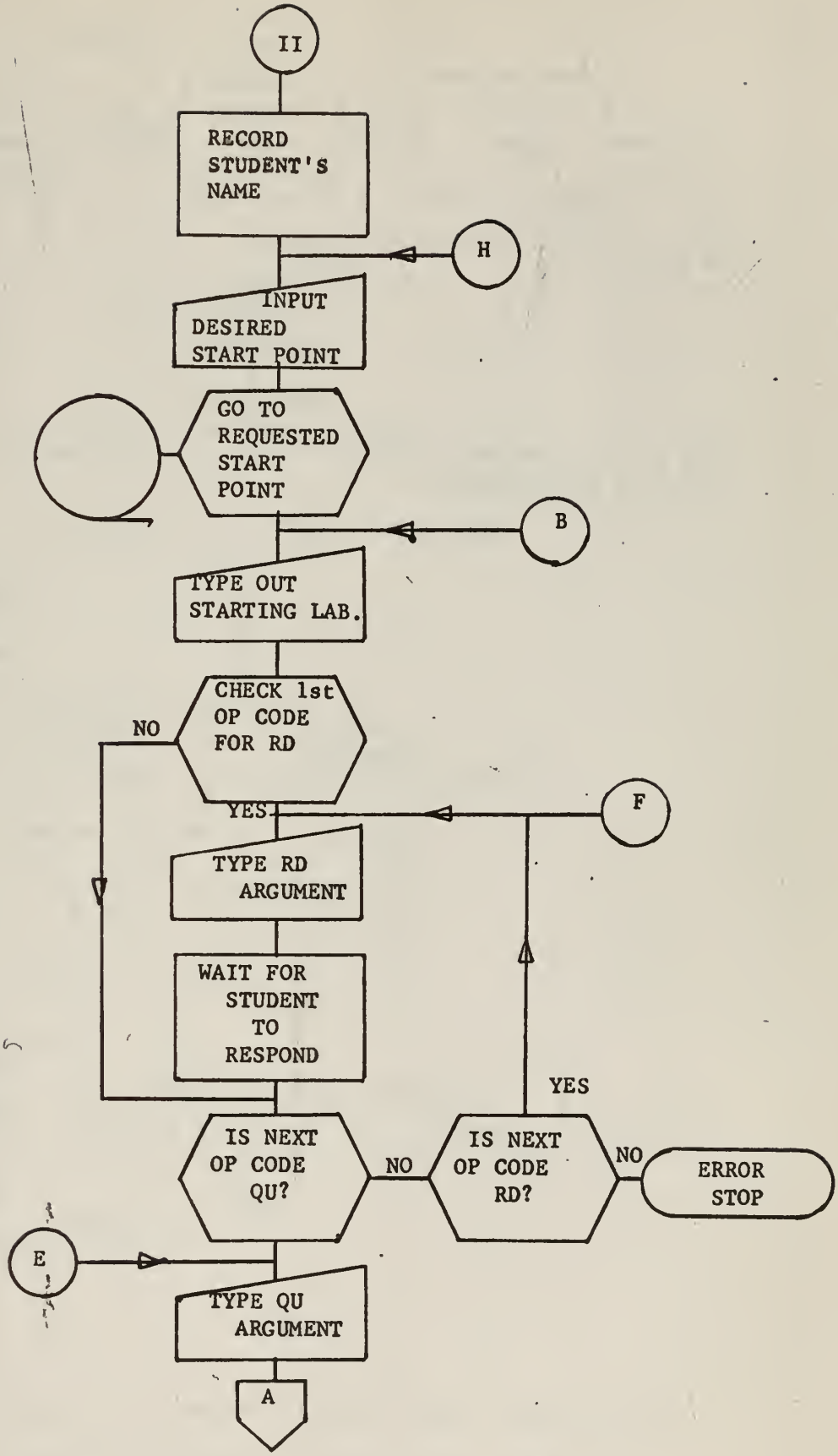


Figure 9. System Flow Diagram - Student Mode (Page 1 of 3)

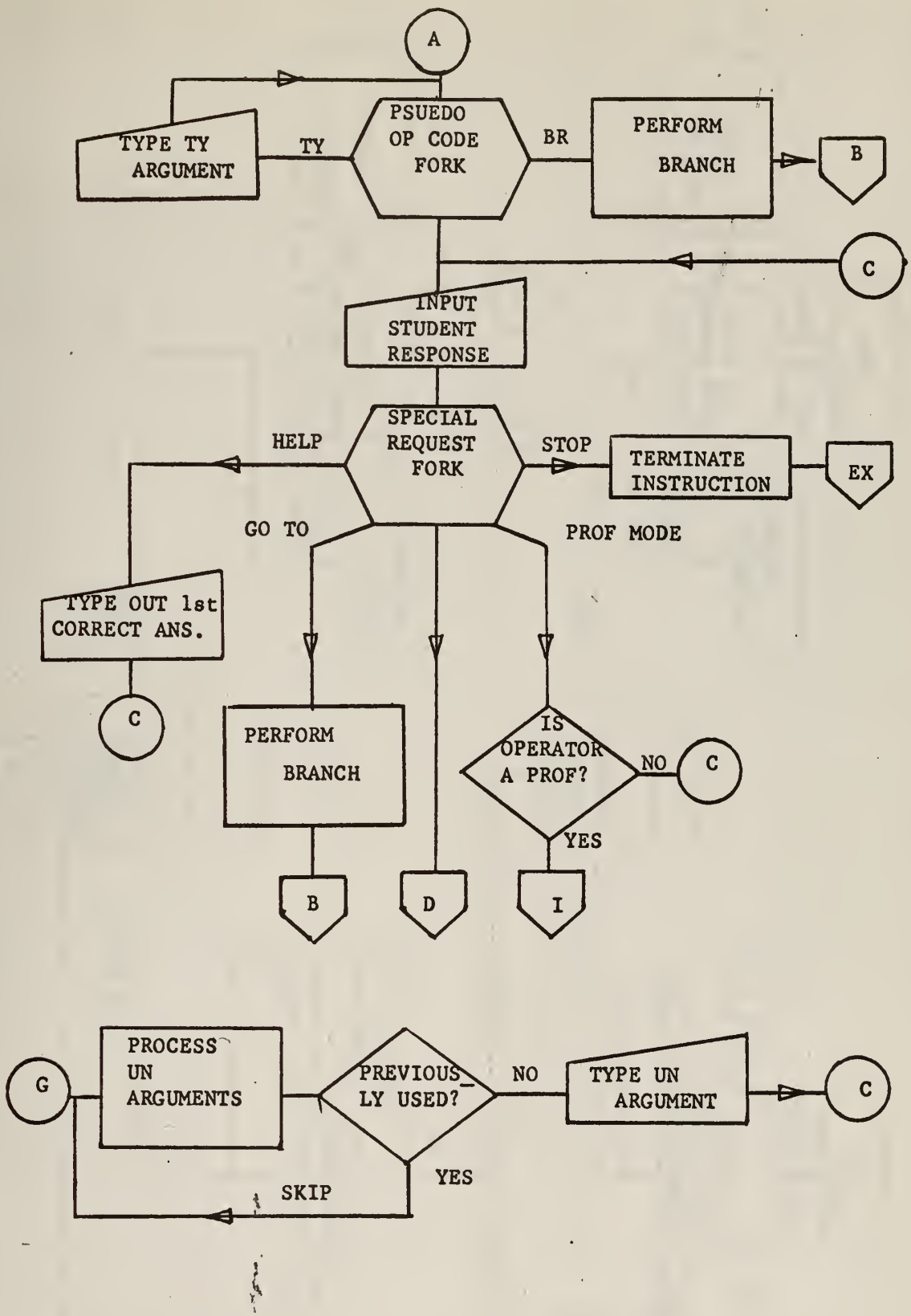


Figure 9. System Flow Diagram - Student Mode (Page 2 of 3)

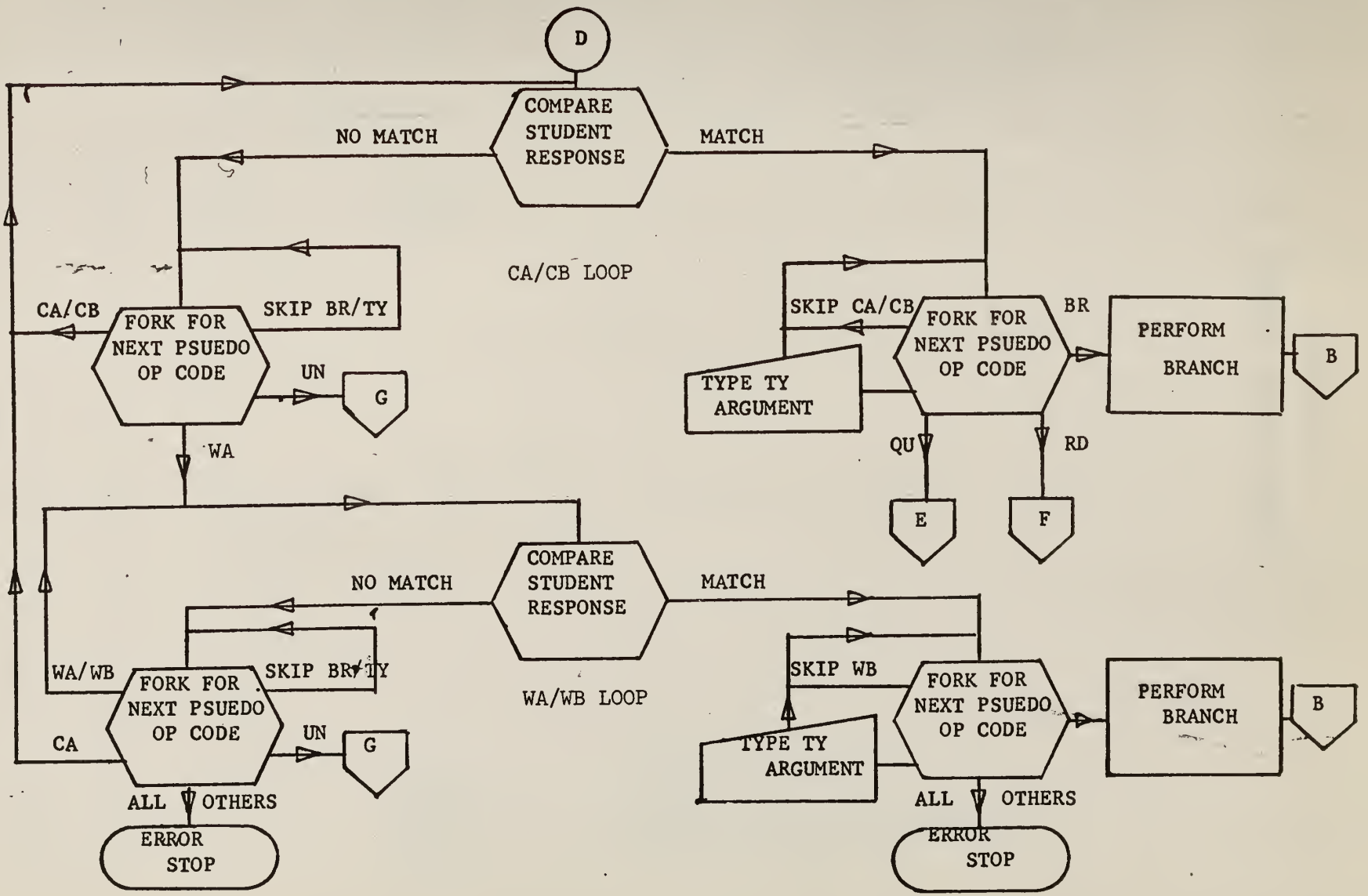


Figure 9. System Flow Diagram - Student Mode (Page 3 of 3)

APPENDIX V

COMPUTER PROGRAM LISTING

```
                        REM
                        REM                 ----------------------------------------
                        REM                 COMPUTER ASSISTED INSTRUCTION
                        REM                 STUDENT AND INSTRUCTOR SECTIONS
                        REM                 28 APRIL 1965    P.D. STOGIS
                        REM                 ----------------------------------------
        0000            CON     0
0000    7101            JFI     1
0001    0100                    100
0002    0322    RELAY           START
0003    1304    RELAY2          START2
0004    5252    ON/OFF          5252
0005    0000    SWITCH
0006    0000    OUTIND
0007    0000    TYPBUF
0010    0000    EOC
0011    0000    LASENT
0012    0000    LANUM
0013    0000    GOTO
0014    0000    EOBFLG
0015    0000    DO
0016    0000    RE
0017    0000    ME
0020    4414    CON1            STOP    +50D
0021    0000    CASE
0022    0000    TEMLTR
0023    0000    NAMBF
0024    0000    MATCOL
0025    0000    MATIND
0026    4333    BUFCOL          STOP    +1
0027    0000    BUFIND
0030    7576    OPLINE          7576
0031    0000    CNTR1
0032    0000    CNTR2
0033    0000    CNTR3
0034    0000    CNTR4
0035    0000    CNTR5
0036    0000    CNTR6
0037    0000    CNTR7
0040    0000    RETURN                          EXIT JUMP ALL SUBROUTINES
0041    2322    BCDOCT          Z9Z001          BCD-OCTAL CONVERSION
0042    2350    TASTAT          Z9Z002          OBTAIN TAPE STATUS
0043    2357    TAPE            Z9Z003          GENERAL TAPE I/O ROUTINE
0044    2444    BCDTYP          Z9Z004          BCD-TYPE CONVERSION  ROUTINE
0045    2532    TYPINP          Z9Z005          INPUT TYPE AND CONVRT TO BCD
0046    2675    PACK            Z9Z006
```

```
0047  2720  MATCH1          Z9Z007      CHECKS ST FOR MATCH
0050  2753  TYPIN           Z9Z008      INPUT TYPE
0051  2767  OCTDEC          Z9Z009
0052  3031  DECBCD          Z9Z010
0053  3042  NUMPK           Z9Z012      PACKS REF NUMBERS FOR LA-BR
0054  3110  OUTTYP          Z9Z013      UNPACKS AND OUT ERROR MSGS
0055  3145  BLKBUF          Z9Z014      SETS BUFFER TO BCD BLANKS
0056  3162  DECOCT          Z9Z015
0057  3260  TYCON           Z9Z016
0060  3342  TAB/LC          Z9Z017
0061  3351  RESCOM          Z9Z018      COMPARE STUDENT RESPONSE
0062  3441  CRSERR          Z9Z019
0063  3451  ADVLNE          Z9Z020
      0070        CON       70
0070  0000  TEMP0                       T
0071  0000  TEMP1                         E
0072  0000  TEMP2                           M
0073  0000  TEMP3                       S     P
0074  0000  TEMP4                           T   O
0075  0000  TEMP5                             O   R
0076  0000  TEMP6                               R
0077  0000  TEMP7                                 E
      0100        PRG
0100  7526  FIRST   EXF     TYST1
0101  7600          INA
0102  6002          ZJF     2
0103  0000          ERR     1           TYPEWRITER NOT RDY
0104  7523          EXF     TAST5
0105  7600          INA
0106  4070          STD     TEMP0
0107  0201          LPN     1
0110  6102          NZF     2
0111  0000          ERR                 WRONG PARITY SELECTED
0112  2070          LDD     TEMP0
0113  0202          LPN     2
0114  6002          ZJF     2
0115  0000          ERR                 TAPE NOT READY
0116  2070          LDD     TEMP0
0117  0240          LPN     40
0120  6111          NZF     BEGIN
0121  7507          EXF     REWND       TAPE UNIT NOT AT LOAD POINT
0122  0101          PTA
0123  7042          JPI     TASTAT
0124  6502          NZB     2
0125  6004          ZJF     BEGIN
0126  4240  TYST1           4240
```

```
0127  1141  TAST5          1141
0130  1161  REWND          1161

0131  0101  BEGIN  PTA                    TYPE = TYPE S FOR STUDENT OR P
0132  7054         JPI    OUTTYP          FOR PROF.
0133  4115                MC6
0134  4140                MC7
0135  0101         PTA
0136  7050         JPI    TYPIN
0137  0715         SBN    15              FLEX P
0140  6005         ZJF    PROF
0141  0707         SBN    7
0142  6507         NZB    7
0143  7101         JFI    1
0144  1211                STUDNT

0145  2020  PROF   LDD    CON1            SET SYMBOL TABLE AREA TO ZERO
0146  4070         STD    TEMPO
0147  0400         LDN    0
0150  4170         STI    TEMPO
0151  5470         AOD    TEMPO
0152  6503         NZB    3
0153  0101         PTA                    TYPE= TYPE O FOR OLD OR N FOR NEW
0154  7054         JPI    OUTTYP
0155  3776                M7
0156  4016                MC1
0157  0101         PTA
0160  7050         JPI    TYPIN
0161  0703         SBN    3               O
0162  6010         ZJF    OLD
0163  0703         SBN    3               N REMAINDER
0164  6507         NZB    7
0165  0400         LDN    0
0166  4012         STD    LANUM
0167  2020         LDD    CON1
0170  4025         STD    MATIND
0171  7002         JPI    RELAY
0172  7512  OLD    EXF    SEOF            READ OVER EOF
0173  0101         PTA
0174  7042         JPI    TASTAT
0175  6502         NZB    OLD     +1      WAIT FOR TAPE RDY
0176  0101         PTA                    START LOOKING FOR CODES THAT INDICATE
0177  7043         JPI    TAPE              START OF SYMBOL TABLE
0200  2131                2131
0201  0070                TEMPO
0202  0075                TEMP5
```

```
0203  0205                      STAOK
0204  1131  SEOF                1131          READ OVER EOF
0205  2070  STACK  LDD   TEMP0
0206  3600         SBC   7777
0207  7777
0210  6516         NZB   OLD                 SYMBOL TABLE NOT FOUND
0211  2071         LDD   TEMP1
0212  4070         STD   TEMP0
0213  0101         PTA
0214  7041         JPI   BCDOCT
0215  0111         LS6
0216  4071         STD   TEMP1               HIGH ORDER 6BITS
0217  2072         LDD   TEMP2
0220  4070         STD   TEMP0
0221  0101         PTA
0222  7041         JPI   BCDOCT
0223  5071         RAD   TEMP1               NUMBER WORDS RQD BY ST
0224  2225         LDF   ST                  FORM
0225  5071         RAD   TEMP1                LWA  +
0226  4224         STF   TERM                    1
0227  4025         STD   MATIND              SET STRT OF ADDI ST ENTRIES
0230  2073         LDD   TEMP3               FORM LANUM
0231  4070         STD   TEMP0
0232  0101         PTA
0233  7041         JPI   BCDOCT
0234  4073         STD   TEMP3
0235  2074         LDD   TEMP4
0236  4070         STD   TEMP0
0237  0101         PTA
0240  7041         JPI   BCDOCT
0241  5073         RAD   TEMP3
0242  4012         STD   LANUM
0243  0101  RST    PTA
0244  7042         JPI   TASTAT
0245  6502         NZB   RST
0246  0101         PTA
0247  7043         JPI   TAPE                READ SYMBOL TABLE
0250  2131                2131
0251  4414  ST            STOP   +50D
0252  0000  TERM
0253  0254                STAOK1
0254  7535  STAOK1 EXF   BKSP2               BKSP OVER EOF
0255  0101         PTA
0256  7042         JPI   TASTAT
0257  6502         NZB   2
0260  7531         EXF   BKSP2               BKSP OVER EOF
```

```
0261  0101            PTA
0262  7042            JPI    TASTAT
0263  6502            NZB    2
0264  7526            EXF    SEOF1            READ OVER EOF
0265  0101            PTA                     OUTPUT (YOUR LAST COURSE
0266  7054            JPI    OUTTYP               ENTRY IS )
0267  3747                   M5
0270  3766                   M6
0271  0101  RCRS       PTA
0272  7042            JPI    TASTAT
0273  6502            NZB    2
0274  0101            PTA
0275  7043            JPI    TAPE             INPUT COURSE LINE
0276  2131                   2131
0277  4332                   STOP
0300  4414                   STOP   +50D
0301  0302                   CONT
0302  0220  CONT       LPN    20               EXECU CONTROL TYPEWRITER
0303  6010            ZJF    CONT3            JUMP IF NO EOF READ
0304  7505            EXF    BKSP2            BKSP OVER EOF
0305  0101            PTA
0306  7042            JPI    TASTAT
0307  6502            NZB    2
0310  6012            ZJF    START
0311  1121  BKSP2             1121
0312  1131  SEOF1             1131
0313  2200  CONT3      LDC    STOP
0314  4332
0315  4027            STD    BUFIND
0316  0101            PTA
0317  7057            JPI    TYCON            OUTPUT LAST COURSE RECORD TO TYPE
0320  7101            JFI    1
0321  0271                   RCRS
0322  0101  START      PTA
0323  7054            JPI    OUTTYP           TYPE = CR,TAB,UC,COLON
0324  4151                   MC8
0325  4156                   MC13
0326  0101            PTA
0327  7055            JPI    BLKBUF
0330  0400            LDN    0
0331  4021            STD    CASE
0332  0101            PTA
0333  7050            JPI    TYPIN            NEW CHARACTER ALSO IN TEMPO
0334  0745            SBN    45
0335  6003            ZJR    CRA
0336  7101            JFI    1
```

```
0337  0676                NCR
0340  2200  CRA     LDC   STOP
0341  4332
0342  4027              STD   BUFIND
0343  2004              LDD   ON/OFF
0344  4005              STD   SWITCH
0345  0476              LDN   76
0346  4072              STD   TEMP2          SET LOWER CASE IN OUT BUF
0347  0101              PTA
0350  7046              JPI   PACK
0351  0420              LDN   20
0352  4072              STD   TEMP2
0353  0101              PTA
0354  7046              JPI   PACK
0355  0512              LCN   10D
0356  4200  LALIM   STC
0357  0000
0360  0101              PTA
0361  7045              JPI   TYPINP         CONVERSION IN A
0362  0101              PTA                   AND TEMP2
0363  7046              JPI   PACK
0364  2072              LDD   TEMP2
0365  0736              SBN   36             EOB CHK
0366  6013              ZJF   LAIN
0367  0717              SBN   17             CR CHK
0370  6004              ZJF   4
0371  5712              AOB   LALIM  +1
0372  6512              NZB   LALIM  +2
0373  6006              ZJF   LAIN
0374  0101              PTA                  ERROR MSG FOR CR IN MIDDLE
0375  7054              JPI   OUTTYP              OF LABEL
0376  3731              M4
0377  3747              M5
0400  7002              JPI   RELAY
0401  2200  LAIN    LDC   STOP
0402  4332
0403  4070              STD   TEMP0
0404  2170              LDI   TEMP0
0405  3600              SBC   7620           BCD LC/SPACE
0406  7620
0407  6141              NZF   MATCH
0410  5470              AOD   TEMP0
0411  2170              LDI   TEMP0
0412  3600              SBC   6671           BCD FI
0413  6671
0414  6117              NZF   CHKSTU
```

```
0415  5470            AOD   TEMPO
0416  2170            LDI   TEMPO
0417  3600            SBC   4571          BCD    NI
0420  4571
0421  6127            NZF   MATCH
0422  5470            AOD   TEMPO
0423  2170            LDI   TEMPO
0424  3600            SBC   2236          BCD S/EOB
0425  2236
0426  6122            NZF   MATCH
0427  0101            PTA
0430  7117            JFI   SYM
0431  7101            JFI   1
0432  0131                  BEGIN
0433  3600    CHKSTU  SBC   3331          BCD ST REMAINDER
0434  3331
0435  6113            NZF   MATCH
0436  5470            AOD   TEMPO
0437  2170            LDI   TEMPO
0440  3600            SBC   2464          BCD   UD
0441  2464
0442  6106            NZF   MATCH
0443  0101            PTA
0444  7103            JFI   SYM
0445  7101            JFI   1
0446  1233                  DIGIT
0447  0541    SYM           STDUMP
0450  0101    MATCH   PTA
0451  7047            JPI   MATCH1
0452  0701            SBN   1
0453  6135            NZF   NOMAT
0454  2124            LDI   MATCOL
0455  6206            PJF   6             JUMP IF NOT FLAGGED AS LABEL
0456  0101            PTA
0457  7054            JPI   OUTTYP        DUPLICATE ERROR LABEL MSG
0460  3720                  M3
0461  3731                  M4
0462  7002            JPI   RELAY
0463  2200            LDC   4000
0464  4000
0465  5124            RAI   MATCOL        INSERT LA FLAG
0466  1200    X5      LPC   777
0467  0777
0470  4070            STD   TEMPO
0471  0101            PTA
0472  7051            JPI   OCTDEC
```

```
0473  2026            LDD   BUFCOL
0474  0610            ADN   8D
0475  4027            STD   BUFIND          SET LOCA OF LA NO. IN OUT BUF
0476  0101            PTA
0477  7053            JPI   NUMPK
0500  7500            EXC   1111
0501  1111
0502  0101            PTA
0503  7043            JPI   TAPE            OUT TYPEWRITER LINE
0504  2111                  2111
0505  4332                  STOP
0506  4414                  STOP    +50D
0507  0322                  START
0510  5412      NOMAT AOD   LANUM
0511  3600            SBC   777
0512  0777
0513  6302            NJF   2
0514  0000            ERR                 GREATER THAN 777 OCTAL
0515  2012            LDD   LANUM
0516  3200            ADC   4000
0517  4000
0520  4125            STI   MATIND
0521  0505            LCN   5
0522  4200            STC
0523  0000
0524  2026            LDD   BUFCOL
0525  4070            STD   TEMP0
0526  2025            LDD   MATIND          TRANSFER NEW LABEL TO ST
0527  4071            STD   TEMP1
0530  5425            AOD   MATIND
0531  2170            LDI   TEMP0
0532  4125            STI   MATIND
0533  5470            AOD   TEMP0
0534  5425            AOD   MATIND
0535  5712            AOB   12
0536  6505            NZB   5
0537  2171            LDI   TEMP1
0540  6552            NZB   X5
0541  0602      STDUMP ADN  2
0542  4077            STD   TEMP7
0543  7500            EXC   1111            WRITE EOF
0544  1111
0545  2200            LDC   7777
0546  7777
0547  4100            STM   NUMBUF
0550  4173
```

```
0551  2200          LDC   NUMBUF +1
0552  4174
0553  4224          STF   Z1      +1
0554  4233          STF   Z2      +1
0555  2200          LDC   NUMBUF +2
0556  4175
0557  4242          STF   Z3      +1
0560  4250          STF   Z4      +1
0561  2012          LDD   LANUM           FORM NUMBER OF
0562  4073          STD   TEMP3
0563  5073          RAD   TEMP3                 CELLS USED
0564  4074          STD   TEMP4
0565  5073          RAD   TEMP3                 BY
0566  5074          RAD   TEMP4                 SYMBOL TABLE
0567  4075          STD   TEMP5
0570  0110    Z5    LS3
0571  0207          LPN   7
0572  4076          STD   TEMP6
0573  0101          PTA
0574  7052          JPI   DECBCD          CONVERT TO BCD
0575  0111          LS6
0576  4100    Z1    STM
0577  0000
0600  2074          LDD   TEMP4
0601  0111          LS6
0602  0207          LPN   7
0603  4076          STD   TEMP6
0604  0101          PTA
0605  7052          JPI   DECBCD
0606  5100    Z2    RAM
0607  0000
0610  2074          LDD   TEMP4
0611  0111          LS6
0612  0110          LS3
0613  0207          LPN   7
0614  4076          STD   TEMP6
0615  0101          PTA
0616  7052          JPI   DECBCD
0617  0111          LS6
0620  4100    Z3    STM
0621  0000
0622  2074          LDD   TEMP4
0623  0207          LPN   7
0624  4076          STD   TEMP6
0625  0101          PTA
0626  7052          JPI   DECBCD
```

```
0627  5100  Z4      RAM
0630  0000
0631  0402          LDN   2
0632  5333          RAB   Z1      +1
0633  0402          LDN   2
0634  5325          RAB   Z2      +1
0635  0402          LDN   2
0636  5315          RAB   Z3      +1
0637  0402          LDN   2
0640  5310          RAB   Z4      +1
0641  3600          SBC   NUMBUF  +6
0642  4201
0643  6004          ZJF   4
0644  2012          LDD   LANUM
0645  4074          STD   TEMP4
0646  6556          NZB   Z5              RETURN FOR LANUM PASS
0647  0101          PTA
0650  7043          JPI   TAPE            DUMP ST CODES
0651  2111                2111
0652  4173                NUMBUF
0653  4200                NUMBUF  +5
0654  0655                RESUM
0655  2075  RESUM  LDD   TEMP5
0656  3205          ADF   FWA
0657  4205          STF   LWA
0660  0101          PTA
0661  7043          JPI   TAPE            OUTPUT SYMBOL TABLE
0662  2111                2111
0663  4414  FWA           STOP    +50D
0664  0000  LWA
0665  0666                RESU
0666  0601  RESU    ADN   1                                          *
0667  6501          NZB   1               DELAY LOOP           *
0670  7500          EXC   1161
0671  1161
0672  0101          PTA
0673  7042          JPI   TASTAT
0674  6502          NZB   2
0675  7077          JPI   TEMP7
0676  2200  NCR     LDC   STOP            START NOT A LABEL ROUTINE
0677  4332
0700  4027          STD   BUFIND
0701  2004          LDD   ON/OFF
0702  4005          STD   SWITCH
0703  0475          LDN   75              TAB
0704  4072          STD   TEMP2
```

```
0705  0101          PTA
0706  7046          JPI   PACK
0707  0476          LDN   76                LOWER CASE
0710  4072          STD   TEMP2
0711  0101          PTA
0712  7046          JPI   PACK
0713  0101          PTA
0714  0606          ADN   6
0715  4077          STD   TCEXIT
0716  2022          LDD   TEMLTR
0717  7101          JFI   1
0720  2536                Z9Z005 +4         SKIP TYPIN OF Z9Z005
0721  0101          PTA
0722  7046          JPI   PACK
0723  0101          PTA
0724  7045          JPI   TYPINP
0725  0101          PTA
0726  7046          JPI   PACK
0727  0501          LCN   1                 DECREASE BUFIND TO COMPENSATE
0730  5027          RAD   BUFIND                FOR PACK ROUTINE
0731  2127          LDI   BUFIND            CHECK FOR NORMAL OP CODE
0732  3600          SBC   2330              TY CHECK
0733  2330
0734  6044          ZJF   NORMOP
0735  3600          SBC   115               UN CHECK
0736  0115
0737  6041          ZJF   NORMOP
0740  3600          SBC   214               WA CHECK
0741  0214
0742  6036          ZJF   NORMOP
0743  0701          SBN   1                 WB CHECK
0744  6034          ZJF   NORMOP
0745  3600          SBC   1645              NX CHECK
0746  1645
0747  6031          ZJF   NORMOP
0750  3600          SBC   275               QU CHECK
0751  0275
0752  6026          ZJF   NORMOP
0753  3600          SBC   140               RD CHECK
0754  0140
0755  6023          ZJF   NORMOP
0756  3600          SBC   1000              AD CHECK
0757  1000
0760  6020          ZJF   NORMOP
0761  0765          SBN   65                BR CHECK
0762  6066          ZJF   BRNOP
```

```
0763  3600            SBC   110              CA CHECK
0764  0110
0765  6013            ZJF   NORMOP
0766  0701            SBN   1                CB  CHECK
0767  6011            ZJF   NORMOP
0770  3600            SBC   263              FN CHECK
0771  0263
0772  6006            ZJF   NORMOP
0773  0101            PTA
0774  7054            JPI   OUTTYP           TYPE=NOT LEGAL CODE
0775  3700                  M1
0776  3720                  M3
0777  7002            JPI   RELAY
1000  5427  NORMOP    AOD   BUFIND           RESET BUFIND
1001  0101            PTA
1002  7054            JPI   OUTTYP           TYPE= 1 SPACE
1003  4156                  MC13
1004  4157                  MC14
1005  0420            LDN   20
1006  4072            STD   TEMP2
1007  0101            PTA
1010  7046            JPI   PACK
1011  0101  NXLN      PTA
1012  7045            JPI   TYPINP
1013  0101            PTA
1014  7046            JPI   PACK
1015  2072            LDD   TEMP2
1016  0736            SBN   36
1017  6017            ZJF   EOB1
1020  0717            SBN   17
1021  6510            NZB   NXLN
1022  0101            PTA
1023  7043            JPI   TAPE             OUT TYPEWRITER LINE
1024  2111                  2111
1025  4332                  STOP
1026  4414                  STOP   +50D
1027  1030                  CONT2
1030  2200  CONT2     LDC   STOP
1031  4332
1032  4027            STD   BUFIND           RESET BUFIND
1033  0101            PTA
1034  7055            JPI   BLKBUF
1035  6424            ZJB   NXLN
1036  0455  EOB1      LDN   55
1037  4072            STD   TEMP2
1040  0101            PTA
```

```
1041  7046            JPI   PACK
1042  0101            PTA
1043  7043            JPI   TAPE              OUT TYPE LINE
1044  2111                  2111
1045  4332                  STOP
1046  4414                  STOP   +50D
1047  0322                  START
1050  5427  BRNOP     AOD   BUFIND            RESET BUFIND
1051  0101            PTA
1052  7054            JPI   OUTTYP            TYPE= 2 SPACES
1053  4156                  MC13
1054  4160                  MC15
1055  0420            LDN   20                ROUTINE TO WORK ON EVEN SYSTEM
1056  4072            STD   TEMP2
1057  0101            PTA
1060  7046            JPI   PACK
1061  0420            LDN   20
1062  4072            STD   TEMP2
1063  0101            PTA
1064  7046            JPI   PACK
1065  0512            LCN   10D               INPUT 10 CHARAC BRANCH DESIG
1066  4200  BRLIM     STC                       OR TO EOB
1067  0000
1070  0101            PTA
1071  7045            JPI   TYPINP
1072  0101            PTA
1073  7046            JPI   PACK
1074  2072            LDD   TEMP2
1075  0736            SBN   36
1076  6013            ZJF   BRIN
1077  0717            SBN   17
1100  6004            ZJF   4
1101  5712            AOB   BRLIM   +1
1102  6512            NZB   BRLIM   +2
1103  6006            ZJF   BRIN
1104  0101            PTA
1105  7054            JPI   OUTTYP            TYPE=CR BEFORE EOB
1106  3731                  M4
1107  3747                  M5
1110  7002            JPI   RELAY
1111  2200  BRIN      LDC   STOP    +3
1112  4335
1113  4026            STD   BUFCOL            ADD 2 TO SKIP OP CODE
1114  0101            PTA
1115  7047            JPI   MATCH1
1116  4070            STD   TEMP0
```

```
1117  2200          LDC   STOP   +1
1120  4333
1121  4026          STD   BUFCOL          RESET
1122  2070          LDD   TEMPO
1123  0701          SBN   1
1124  6131          NZF   NOMAT1
1125  2124          LDI   MATCOL
1126  0102          LS1
1127  6203          PJF   3
1130  2124          LDI   MATCOL
1131  6104          NZF   X1
1132  2200          LDC   2000
1133  2000
1134  5124          RAI   MATCOL          FLAG AS BRANCH
1135  1200  X1      LPC   777
1136  0777
1137  4070          STD   TEMPO
1140  0101          PTA
1141  7051          JPI   OCTDEC
1142  2026          LDD   BUFCOL
1143  0610          ADN   8D              LOCA  IN PACKED OUT BUF
1144  4027          STD   BUFIND
1145  0101          PTA
1146  7053          JPI   NUMPK           ADD DESIG NO. TO PACKED LINE
1147  0101          PTA
1150  7043          JPI   TAPE
1151  2111                2111
1152  4332                STOP
1153  4414                STOP   +50D
1154  0322                START
1155  5412  NOMAT1  AOD   LANUM
1156  3600          SBC   777
1157  0777
1160  6302          NJF   2
1161  0000          ERR
1162  2012          LDD   LANUM           SET DESIG NUMBER
1163  3200          ADC   2000            ADD BR FLAG
1164  2000
1165  4124          STI   MATCOL
1166  0505          LCN   5
1167  4200          STC
1170  0000
1171  2026          LDD   BUFCOL             AND SHIFT NEW
1172  0602          ADN   2
1173  4070          STD   TEMPO
1174  2025          LDD   MATIND
```

```
1175  4071            STD   TEMP1          DESIG TO SYMBOL
1176  5425            AOD   MATIND
1177  2170            LDI   TEMP0
1200  4125            STI   MATIND
1201  5470            AOD   TEMP0
1202  5425            AOD   MATIND         TABLE
1203  5713            AOB   13
1204  6505            NZB   5
1205  0600            06
1206  0600            06
1207  2171            LDI   TEMP1
1210  6553            NZB   X1

1211  2200  STUDNT    LDC   NAMBUF
1212  4161
1213  4023            STD   NAMBF
1214  0101            PTA                  TYPE= TYPE LAST NAME
1215  7054            JPI   OUTTYP
1216  4016                  MC1
1217  4027                  MC2
1220  0512            LCN   10D
1221  4200            STC
1222  0000
1223  0101            PTA
1224  7045            JPI   TYPINP
1225  0736            SBN   36
1226  6005            ZJF   5
1227  4123            STI   NAMBF
1230  5423            AOD   NAMBF
1231  5707            AOB   7
1232  6507            NZB   7
1233  0101  DIGIT     PTA
1234  7054            JPI   OUTTYP         TYPE= TYPE DESIRED 4 DIGIT START NUMBER
1235  4027                  MC2
1236  4053                  MC4
1237  2200            LDC   STOP
1240  4332
1241  4027            STD   BUFIND
1242  0400            LDN   0
1243  4021            STD   CASE
1244  2004            LDD   ON/OFF
1245  4005            STD   SWITCH
1246  0505            LCN   5              INPUT 4 NUMBERS AND EOB
1247  4200            STC
1250  0000
1251  0101            PTA
```

```
1252  7045          JPI   TYPINP
1253  0101  MARK    PTA
1254  7046          JPI   PACK
1255  5705          AOB   5
1256  6505          NZB   5
1257  2072          LDD   TEMP2
1260  0736          SBN   36
1261  6526          NZB   DIGIT
1262  0101          PTA
1263  7056          JPI   DECOCT
1264  4332          STOP
1265  4333          STOP  +1
1266  2070          LDD   TEMP0
1267  6434          ZJB   DIGIT          DO NOT ACCEPT 0000
1270  4013          STD   GOTO
1271  7527          EXF   SEOF2
1272  7525          EXF   TAST7
1273  7600          INA
1274  0222          LPN   22
1275  6003          ZJF   3              EOF READ AND TAPE RDY
1276  0202          LPN   2
1277  6505          NZB   5              WAIT FOR RDY
1300  0400          LDN   0
1301  4031          STD   CNTR1
1302  7101          JFI   1
1303  2240                TASRCH
1304  2200  START2  LDC   CRSBUF
1305  4332
1306  4206          STF   FWA3
1307  0662          ADN   50D
1310  4205          STF   LWA3
1311  0101          PTA
1312  7043          JPI   TAPE
1313  2131                2131
1314  0000  FWA3
1315  0000  LWA3
1316  1321                INAGAN
1317  1141  TAST7         1141
1320  1131  SEOF2         1131
1321  0220  INAGAN  LPN   20
1322  6115          NZF   EOF
1323  2307          LDB   FWA3           CHECK FOR END OF COURSE
1324  4202          STF   2
1325  2500          LCM
1326  0000
1327  6103          NZF   3
```

```
1330  7101          JFI   1
1331  2311                ERROR  +4
1332  0462          LDN   50D
1333  5317          RAB   FWA3
1334  0462          LDN   50D
1335  5320          RAB   LWA3
1336  6525          NZB   START2 +5
1337  2322    EOF   LDB   LWA3          SAVE ENDING ADDR +50 OF COURSE BLOCK
1340  4011          STD   LASENT              READ IN BEFORE EOF
1341  2200          LDC   CRSBUF
1342  4332
1343  4007          STD   TYPBUF        START INDEX ON EACH COURSE LINE
1344  4027          STD   BUFIND
1345  2107          LDI   TYPBUF
1346  3600          SBC   7620          CHECK 1ST REC FOR LABEL
1347  7620
1350  6003          ZJF   3
1351  0101          PTA
1352  7062          JPI   CRSERR
1353  0101          PTA
1354  7054          JPI   OUTTYP        TYPE = CR
1355  4151                MC8
1356  4152                MC9
1357  0101          PTA                 CONVERT BCD TO TYPE, EXIT AT CR
1360  7057          JPI   TYCON         AND SET UP OUTTYP
1361  0101          PTA
1362  7056          JPI   DECOCT
1363  4344                CRSBUF +10D
1364  4345                CRSBUF +11D
1365  2070          LDD   TEMPO
1366  4012          STD   LANUM         STORE LABEL NO. PRESENT BLK
1367  0101          PTA
1370  7063          JPI   ADVLNE
1371  5427          AOD   BUFIND        SKIP TAB/LC
1372  2127          LDI   BUFIND
1373  3600          SBC   5164          RD
1374  5164
1375  6136          NZF   QU
1376  0101          PTA
1377  7060          JPI   TAB/LC
1400  5427    MORE  AOD   BUFIND        SKIP RD OP CODE
1401  0101          PTA
1402  7057          JPI   TYCON
1403  0101          PTA
1404  7063          JPI   ADVLNE
1405  2014          LDD   EOBFLG
```

```
1406  6405          ZJB   MORE    +1      LOOP FOR ALL LINES OF RD
1407  0101          PTA
1410  7045          JPI   TYPINP
1411  0736          SBN   36              CHKING FOR EOB RESPONSE TO RD
1412  6503          NZB   3
1413  0101          PTA
1414  7054          JPI   OUTTYP          TYPE = CR
1415  4151                MC8
1416  4152                MC9
1417  5427          AOD   BUFIND          SKIP TAB/LC
1420  2127          LDI   BUFIND
1421  3600          SBC   5024            QU
1422  5024
1423  6006          ZJF   QU      -2
1424  3600          SBC   140             RD REMAINDER
1425  0140
1426  6430          ZJB   MORE    -2      ANOTHER RD
1427  0101          PTA
1430  7062          JPI   CRSERR
1431  0101          PTA
1432  7060          JPI   TAB/LC
1433  5427    QU    AOD   BUFIND          SKIP OP CODE
1434  0101          PTA
1435  7057          JPI   TYCON
1436  0101          PTA
1437  7063          JPI   ADVLNE
1440  2027          LDD   BUFIND
1441  4017          STD   ME
1442  2014          LDD   EOBFLG
1443  6407          ZJB   QU      +1
1444  5427          AOD   BUFIND          SKIP TAB/LC
1445  2127          LDI   BUFIND
1446  3600          SBC   2330            TY
1447  2330
1450  6417          ZJB   QU      -2      ROUTINE SAME AS FOR QU
1451  3600          SBC   3634            AD REMAINDER
1452  3634
1453  6102          NZF   2
1454  7700          HLT
1455  0765          SBN   65              BR REMAINDER
1456  6103          NZF   3
1457  7101          JFI   1
1460  2204                BR
1461  3600          SBC   110             CA REMAINDER
1462  0110
1463  6003          ZJF   INRES
```

```
1464  0101          PTA
1465  7062          JPI    CRSERR          CA NOT FIRST MAJOR FOLLOWING QU
1466  0101  INRES   PTA
1467  7054          JPI    OUTTYP          TYPE = LC
1470  4155                 MC12
1471  4156                 MC13
1472  2200          LDC    RESBUF          START OF INPU RESPONSE
1473  4200
1474  4027          STD    BUFIND
1475  2004          LDD    ON/OFF
1476  4005          STD    SWITCH
1477  0400          LDN    0
1500  4021          STD    CASE
1501  0101          PTA
1502  7045          JPI    TYPINP
1503  0720  MARK2   SBN    20              SPACE
1504  6403          ZJB    3               SKIP SPACES
1505  0716          SBN    16              EOB REMAINDER
1506  6006          ZJF    6
1507  0717          SBN    17              CR REMAINDER
1510  6422          ZJB    INRES
1511  0101          PTA
1512  7046          JPI    PACK
1513  6512          NZB    12
1514  0101          PTA
1515  7046          JPI    PACK            PACK IN EOB
1516  0101          PTA
1517  7054          JPI    OUTTYP          TYPE = CR
1520  4151                 MC8
1521  4152                 MC9
1522  2200          LDC    RESBUF
1523  4200
1524  4070          STD    TEMPO
1525  2170          LDI    TEMPO
1526  3600          SBC    2223            BCD ST
1527  2223
1530  6114          NZF    A1
1531  5470          AOD    TEMPO
1532  2170          LDI    TEMPO
1533  3600          SBC    4647            BCD OP
1534  4647
1535  6136          NZF    A2      +7
1536  0101          PTA
1537  7054          JPI    OUTTYP          TYPE= INSTRUCTION TERMINATED
1540  4100                 MC5.1
1541  4115                 MC6
```

```
1542  7101          JFI   1
1543  0100                FIRST
1544  3600    A1    SBC   4523          GO REMAINDER
1545  4523
1546  6116          NZF   A2
1547  5470          AOD   TEMPO
1550  2170          LDI   TEMPO
1551  3600          SBC   2346          BCD TO
1552  2346
1553  6166          NZF   ACONT
1554  0101          PTA
1555  7056          JPI   DECOCT
1556  4202                RESBUF +2
1557  4203                RESBUF +3
1560  0400          LDN   0
1561  4031          STD   CNTR1
1562  7101          JFI   1
1563  2217                BRX
1564  3600    A2    SBC   117           HE REMAINDER
1565  0117
1566  6134          NZF   A3
1567  5470          AOD   TEMPO
1570  2170          LDI   TEMPO
1571  3600          SBC   4347          BCD LP
1572  4347
1573  6146          NZF   ACONT
1574  2200          LDC   CRSBUF        HELP ROUTINE. LOOK FOR CA
1575  4332
1576  4077          STD   TEMP7
1577  5477          AOD   TEMP7         SKIP TAB/LC
1600  2177          LDI   TEMP7
1601  3600          SBC   6361          CA
1602  6361
1603  6004          ZJF   4
1604  0462          LDN   50D
1605  5077          RAD   TEMP7
1606  6506          NZB   6
1607  0101          PTA
1610  7054          JPI   OUTTYP        TYPE=THE CORRECT ANSWER IS
1611  4053                MC4
1612  4070                MC5
1613  2077          LDD   TEMP7
1614  5477          AOD   TEMP7         SKIP OP CODE
1615  4027          STD   BUFIND
1616  0101          PTA
1617  7057          JPI   TYCON
```

```
1620  7101            JFI   1
1621  1466                  INRES
1622  3600  A3        SBC   5663          PR REMAINDER
1623  5663
1624  6115            NZF   ACONT
1625  5470            AOD   TEMP0
1626  2170            LDI   TEMP0
1627  3600            SBC   4666          BCD  OF
1630  4666
1631  6110            NZF   ACONT
1632  7505            EXF   REWND1        SEND TAPE TO LOAD POINT
1633  0101            PTA
1634  7042            JPI   TASTAT
1635  6502            NZB   2
1636  7102            JFI   RELY          GO TO PROF ROUTINE
1637  1161  REWND1          1161
1640  0172  RELY            OLD
1641  2007  ACONT    LDD   TYPBUF
1642  4073            STD   TEMP3
1643  5473            AOD   TEMP3         SKIP TAB/LC
1644  2200            LDC   RESBUF
1645  4200
1646  4074            STD   TEMP4
1647  5473            AOD   TEMP3         SKIP OP CODE
1650  0101            PTA
1651  7061            JPI   RESCOM
1652  6065            ZJF   WRONG
1653  0101  RIGHT    PTA
1654  7063            JPI   ADVLNE
1655  2127            LDI   BUFIND
1656  3430            SBD   OPLINE
1657  6504            NZB   4             LINE DOES NOT CONTAIN OP CODE
1660  5427  GOAGN    AOD   BUFIND         SKIP TAB/LC
1661  2127            LDI   BUFIND
1662  3600            SBC   6361          CA
1663  6361
1664  6411            ZJB   RIGHT
1665  0701            SBN   1             CB REMAINDER
1666  6413            ZJB   RIGHT
1667  3600            SBC   3745          TY REMAINDER
1670  3745
1671  6113            NZF   ADCHK
1672  0101            PTA
1673  7060            JPI   TAB/LC
1674  5427            AOD   BUFIND        SKIP OP CODE
1675  0101            PTA
```

```
1676  7057            JPI   TYCON
1677  0101            PTA
1700  7063            JPI   ADVLNE
1701  2014            LDD   EOBFLG
1702  6405            ZJB   GOAGN   +13D
1703  6523            NZB   GOAGN
1704  3600  ADCHK     SBC   3634            AD REMAINDER
1705  3634
1706  6102            NZF   2
1707  7700            HLT
1710  0765            SBN   65              BR REMAINDER
1711  6113            NZF   13
1712  7101            JFI   1
1713  2204                  BR
1714  0101            PTA
1715  7063            JPI   ADVLNE
1716  2127            LDI   BUFIND
1717  3430            SBD   OPLINE
1720  6504            NZB   4               LINE DOES NOT CONTAIN OP CODE
1721  3600            SBC   5164            RD
1722  5164
1723  6107            NZF   7
1724  6004            ZJF   4
1725  3600            SBC   6777            RD REMAINDER
1726  6777
1727  6103            NZF   3
1730  7101            JFI   1
1731  1376                  MORE    -2
1732  3600            SBC   7637            QU REMAINDER
1733  7637
1734  6520            NZB   20
1735  7101            JFI   1
1736  1431                  QU      -2
1737  0101  WRONG     PTA
1740  7063            JPI   ADVLNE
1741  2 27            LDI   BUFIND
1742  3430            SBD   OPLINE
1743  6504            NZB   4
1744  5427            AOD   BUFIND          SKIP TAB/LC
1745  2127            LDI   BUFIND
1746  3600            SBC   6362            CB
1747  6362
1750  6105            NZF   5
1751  2027            LDD   BUFIND
1752  4073            STD   TEMP3           SET UP RESCOM
1753  7101            JFI   1
```

```
1754  1644                    ACONT  +3
1755  3600          SBC       4276          WA REMAINDER
1756  4276
1757  6033          ZJF       WA
1760  3600          SBC       7563          UN REMAINDER
1761  7563
1762  6103          NZF       NX
1763  7101          JFI       1
1764  2135                    UN
1765  3600    NX    SBC       2062          NX REMAINDER
1766  2062
1767  6102          NZF       2
1770  7700          HLT
1771  3600          SBC       1522          BR REMAINDER
1772  1522
1773  6434          ZJB       WRONG
1774  0665          ADN       65            AD  REMAINDER
1775  6436          ZJB       WRONG
1776  3600          SBC       4143          TY REMAINDER
1777  4143
2000  6441          ZJB       WRONG
2001  3600          SBC       4031          CA REMAINDER
2002  4031
2003  6105          NZF       5
2004  2027          LDD       BUFIND
2005  4073          STD       TEMP3
2006  7101          JFI       1             START NEW CA/CB BLOCK
2007  1644                    ACONT  +3
2010  0101          PTA
2011  7062          JPI       CRSERR
2012  2027    WA    LDD       BUFIND
2013  4073          STD       TEMP3
2014  2200          LDC       RESBUF
2015  4200
2016  4074          STD       TEMP4
2017  5473          AOD       TEMP3
2020  0101          PTA
2021  7061          JPI       RESCOM
2022  6103          NZF       RIGHT1
2023  7101          JFI       1
2024  2071                    WRONG1
2025  0101    RIGHT1 PTA
2026  7063          JPI       ADVLNE
2027  2127          LDI       BUFIND
2030  3430          SBD       OPLINE
2031  6504          NZB       4
```

```
2032  5427   GOAGN1  AOD   BUFIND          SKIP TAB/LC
2033  2127           LDI   BUFIND
2034  3600           SBC   2330            TY
2035  2330
2036  6113           NZF   ADCHK1
2037  0101           PTA
2040  7060           JPI   TAB/LC
2041  5427           AOD   BUFIND          SKIP OP CODE
2042  0101           PTA
2043  7057           JPI   TYCON
2044  0101           PTA
2045  7063           JPI   ADVLNE
2046  2014           LDD   EOBFLG
2047  6405           ZJB   GOAGN1 +10
2050  6516           NZB   GOAGN1
2051  3600   ADCHK1  SBC   3634            AD REMAINDER
2052  3634
2053  6102           NZF   2
2054  7700           HLT
2055  0765           SBN   65              BR REMAINDER
2056  6103           NZF   3
2057  7101           JFI   1
2060  2204                 BR
2061  3600           SBC   4407            WA  REMAINDER
2062  4407
2063  6003           ZJF   3
2064  0701           SBN   1               WB REMAINDER
2065  6440           ZJB   RIGHT1
2066  2017           LDD   ME
2067  4007           STD   TYPBUF
2070  7170           JFI   JUMP
2071  0101   WRONG1  PTA
2072  7063           JPI   ADVLNE
2073  2127           LDI   BUFIND
2074  3430           SBD   OPLINE
2075  6504           NZB   4
2076  5427           AOD   BUFIND          SKIP TAB/LC
2077  2127           LDI   BUFIND
2100  3600           SBC   2662            WB
2101  2662
2102  6470           ZJB   WA
2103  0601           ADN   1               WA REMAINDER
2104  6472           ZJB   WA
2105  3600           SBC   7563            UN REMAINDER
2106  7563
2107  6026           ZJF   UN
```

```
2110  3600          SBC   2062          NX REMAINDER
2111  2062
2112  6102          NZF   2
2113  7700          HLT
2114  3600          SBC   1522          BR REMAINDER
2115  1522
2116  6425          ZJB   WRONG1
2117  0665          ADN   65            AD REMAINDER
2120  6427          ZJB   WRONG1
2121  3600          SBC   4143          TY REMAINDER
2122  4143
2123  6432          ZJB   WRONG1
2124  3600          SBC   4031          CA REMAINDER
2125  4031
2126  6105          NZF   5
2127  2027          LDD   BUFIND
2130  4073          STD   TEMP3
2131  7101          JFI   1
2132  1644                ACONT  +3     START NEW CA/CB BLOCK
2133  0101          PTA
2134  7062          JPI   CRSERR
2135  5427    UN    AOD   BUFIND        SKIP OP CODE
2136  2127          LDI   BUFIND
2137  1200          LPC   7700
2140  7700
2141  6020          ZJF   USED
2142  2127          LDI   BUFIND        MAKE SPACE FOLLOWING UN OP CODE ZERO
2143  0277          LPN   77               WHEN UN IS USED
2144  4127          STI   BUFIND
2145  0101          PTA
2146  7060          JPI   TAB/LC
2147  0101          PTA
2150  7057          JPI   TYCON
2151  0101          PTA
2152  7063          JPI   ADVLNE
2153  2014          LDD   EOBFLG
2154  6405          ZJB   UN      +12
2155  2017          LDD   ME
2156  4007          STD   TYPBUF
2157  7101          JFI   1
2160  1466    JUMP        INRES
2161  0101    USED  PTA
2162  7063          JPI   ADVLNE
2163  2127          LDI   BUFIND
2164  3430          SBD   OPLINE
2165  6504          NZB   USED
```

```
2166  5427          AOD   BUFIND          SKIP TAB/LC
2167  2127          LDI   BUFIND
2170  3600          SBC   2445            UN
2171  2445
2172  6435          ZJB   UN
2173  3600          SBC   3604            BR REMAINDER
2174  3604
2175  6103          NZF   3
2176  6006          ZJF   BR
2177  3600          SBC   5056            TY REMAINDER
2200  5056
2201  6444          ZJB   UN
2202  0101          PTA
2203  7062          JPI   CRSERR
2204  0400    BR    LDN   0
2205  4031          STD   CNTR1
2206  2007          LDD   TYPBUF
2207  0612          ADN   10D
2210  4205          STF   DCALL  +2       PICK UP DESIRED BRANCH NUMBER
2211  4205          STF   DCALL  +3
2212  5604          AOF   DCALL  +3
2213  0101  DCALL   PTA
2214  7056          JPI   DECOCT
2215  0000          BSS   2
2217  2070    BRX   LDD   TEMPO
2220  4013          STD   GOTO
2221  3412          SBD   LANUM           PRESENT BLOCK NUMBER
2222  6116          NZF   TASRCH
2223  7524    HERE  EXF   BOEOF
2224  0101          PTA
2225  7042          JPI   TASTAT
2226  6502          NZB   2
2227  7520          EXF   BOEOF
2230  0101          PTA
2231  7042          JPI   TASTAT
2232  6502          NZB   2
2233  7513          EXF   ROVREF
2234  0101          PTA
2235  7042          JPI   TASTAT
2236  6502          NZB   2
2237  7003          JPI   RELAY2
2240  0101  TASRCH  PTA
2241  7043          JPI   TAPE            LINE INPUT
2242  2131                2131
2243  4332    FWA1        CRSBUF
2244  4414    LWA1        CRSBUF +50D
```

```
2245   2250                        OK1
2246   1131   ROVREF               1131
2247   1121   BOEOF                1121
2250   2305   OK1      LDB    FWA1
2251   4202            STF    2
2252   2500            LCM
2253   0000
2254   6104            NZF    4
2255   2031            LDD    CNTR1
2256   6021            ZJF    BACKW
2257   6126            NZF    ERROR
2260   0101            PTA
2261   7056            JPI    DECOCT
2262   4344                   CRSBUF  +10D
2263   4345                   CRSBUF  +11D
2264   2013            LDD    GOTO
2265   3470            SBD    TEMP0
2266   6006            ZJF    FOUND
2267   7530            EXF    ROVEF
2270   0101            PTA
2271   7042            JPI    TASTAT
2272   6502            NZB    2
2273   6433            ZJB    TASRCH
2274   7525   FOUND    EXF    BOVEOF
2275   7600            INA
2276   7003            JPI    RELAY2
2277   5431   BACKW    AOD    CNTR1
2300   7520            EXF    REWIN
2301   0101            PTA
2302   7042            JPI    TASTAT
2303   6502            NZB    2
2304   6415            ZJB    FOUND   -5
2305   0101   ERROR    PTA
2306   7054            JPI    OUTTYP
2307   4140                   MC7
2310   4151                   MC8
2311   0101            PTA
2312   7054            JPI    OUTTYP
2313   4100                   MC5.1
2314   4115                   MC6
2315   7101            JFI    1
2316   0131                   BEGIN
2317   1131   ROVEF            1131
2320   1161   REWIN            1161
2321   1121   BOVEOF           1121
```

```
                         REM
                         REM
                         REM
2322  0602   Z9Z001  ADN   2          BCDOCT SPECIAL CON-
2323  4040           STD   RETURN      VERSION FOR NUMBER
2324  2070           LDD   TEMPO       OF WORDS IN LA-BR
2325  0111           LS6               SYMBOL TABLE
2326  0277           LPN   77          TEMPO HAS TWO BCD
2327  0712           SBN   12          CHARACTERS
2330  6103           NZF   3           LEAVES 00XX IN A
2331  4022           STD   TEMLTR
2332  6006           ZJF   6
2333  2070           LDD   TEMPO
2334  0111           LS6
2335  0207           LPN   7
2336  0110           LS3
2337  4022           STD   TEMLTR
2340  2070           LDD   TEMPO
2341  0277           LPN   77
2342  0712           SBN   12
2343  6003           ZJF   3
2344  2070           LDD   TEMPO
2345  0207           LPN   7
2346  5022           RAD   TEMLTR
2347  7040           JPI   RETURN

                         REM
                         REM
                         REM
2350  0602   Z9Z002  ADN   2          CHECKS TAPE STATUS
2351  4075           STD   TEMP5       FOR READY  RESULT
2352  7500           EXC   1141
2353  1141
2354  7600           INA               IN A REGISTER
2355  0202           LPN   2
2356  7075           JPI   TEMP5

                         REM
                         REM
                         REM
                         REM           TAPE
2357  0602   Z9Z003  ADN   2
2360  4040           STD   RETURN
2361  2140           LDI   RETURN
2362  4256           STF   RDORWR      SET EXF CODE
```

```
2363  0220          LPN   20
2364  0103          LS2
2365  4220          STF   ADDR
2366  2200          LDC   7300
2367  7300
2370  3615          SBF   ADDR
2371  0632          ADN   FWA.    -ADDR
2372  4213          STF   ADDR              SET IN OR OUT
2373  5440          AOD   RETURN
2374  2140          LDI   RETURN
2375  4242          STF   FWA.
2376  5440          AOD   RETURN
2377  2140          LDI   RETURN
2400  4206          STF   LWA.
2401  5440          AOD   RETURN
2402  2140          LDI   RETURN
2403  4040          STD   RETURN            SET RETURN ADDR
2404  7534          EXF   RDORWR
2405  0000  ADDR                           IN OR OUT CODE
2406  0000  LWA.
2407  7532          EXF   TAST.
2410  7600          INA
2411  0226          LPN   26
2412  6017          ZJF   EXIT              NO EOF OR PARITY. TAPE READY
2413  0224          LPN   24
2414  6405          ZJB   5                 TAPE NOT READY
2415  0220          LPN   20
2416  6113          NZF   EXIT              EOF READ. 0020 IN A
2417  4624          SRF   PARSW
2420  6202          PJF   2
2421  0000          ERR                     PARITY ERROR ON 3 READS
2422  7520          EXF   BKSP.
2423  7600          INA
2424  7515          EXF   TAST.
2425  7600          INA
2426  0202          LPN   2
2427  6503          NZB   3                 WAIT FOR READY
2430  6424          ZJB   ADDR    -1
2431  4207  EXIT    STF   RDORWR
2432  2200          LDC   4444
2433  4444
2434  4207          STF   PARSW
2435  2203          LDF   RDORWR
2436  7040          JPI   RETURN
2437  0000  FWA.
2440  0000  RDORWR
```

```
2441  1141   TAST.          1141
2442  1121   BKSP.          1121
2443  4444   PARSW          4444

                    REM
                    REM
2444  0602   Z9Z004 ADN    2              BCDTYP
2445  4040          STD    RETURN
2446  2070          LDD    TEMPO
2447  0716          SBN    16
2450  6105          NZF    EOB
2451  0401          LDN    1
2452  4021          STD    CASE
2453  0447          LDN    47
2454  6155          NZF    RETCH
2455  0720   EOB    SBN    20
2456  6105          NZF    LC2
2457  0401          LDN    1
2460  4014          STD    EOBFLG
2461  0404          LDN    4              OUTPUT SPACE FOR EOB
2462  6147          NZF    RETCH
2463  0740   LC2    SBN    40
2464  6105          NZF    CHARAC
2465  0400          LDN    0
2466  4021          STD    CASE
2467  0457          LDN    57
2470  6141          NZF    RETCH
2471  2021   CHARAC LDD    CASE
2472  6120          NZF    UPC2
2473  2200          LDC    CNLC
2474  3500
2475  4202          STF    2
2476  2100          LDM
2477  0000
2500  3470          SBD    TEMPO
2501  6104          NZF    4
2502  2303          LDB    3
2503  0277          LPN    77
2504  6125          NZF    RETCH
2505  5706          AOB    6
2506  3600          SBC    CNUC
2507  3600
2510  6512          NZB    12
2511  0000          ERR
2512  2200   UPC2   LDC    CNUC
2513  3600
```

```
2514  4202           STF   2
2515  2100           LDM
2516  0000
2517  3470           SBD   TEMPO
2520  6104           NZF   4
2521  2303           LDB   3
2522  0277           LPN   77
2523  6106           NZF   RETCH
2524  5706           AOB   6
2525  3600           SBC   M1
2526  37C0
2527  6512           NZB   12
2530  0000           ERR
2531  7040  RETCH    JPI   RETURN

                     REM
                     REM
                     REM
2532  0602  Z9Z005   ADN   2          INPUT TYPE TO BCD
2533  4077           STD   TCEXIT      CONVERSION
2534  0101           PTA               RESULT IN TEMP2. USES
2535  7050           JPI   TYPIN       Z9Z008 AS A S.R.
2536  0747  CNA      SBN   47
2537  6106           NZF   CNB
2540  0401           LDN   1
2541  4021           STD   CASE        SET CASE TO 1 WHEN UPPER
2542  0416           LDN   16
2543  4072           STD   TEMP2
2544  7077           JPI   TCEXIT
2545  2022  CNB      LDD   TEMLTR
2546  0757           SBN   57
2547  6106           NZF   CNC
2550  0400           LDN
2551  4021           STD   CASE        SET CASE TO 0 WHEN LOWER
2552  0476           LDN   76
2553  4072           STD   TEMP2
2554  7077           JPI   TCEXIT
2555  2022  CNC      LDD   TEMLTR
2556  0745           SBN   45          CR CHECK
2557  6104           NZF   CND
2560  0455           LDN   55          BCD FOR CR
2561  4072           STD   TEMP2
2562  7077           JPI   TCEXIT
2563  2022  CND      LDD   TEMLTR
2564  0742           SBN   42          PERIOD CHECK
2565  6116           NZF   CNE
```

```
2566  0101          PTA
2567  7050          JPI   TYPIN
2570  0742          SBN   42
2571  6104          NZF   CNF             JUMP IF NOT 2ND PERIOD
2572  0436          LDN   36              BCD FOR EOB
2573  4072          STD   TEMP2
2574  7077          JPI   TCEXIT
2575  0473    CNF   LDN   73
2576  4072          STD   TEMP2
2577  0101          PTA
2600  7046          JPI   PACK
2601  2022          LDD   TEMLTR
2602  6544          NZB   CNA
2603  2022    CNE   LDD   TEMLTR
2604  0740          SBN   40              COMMA CHECK
2605  6152          NZF   CNG
2606  0101          PTA
2607  7050          JPI   TYPIN
2610  0740          SBN   40
2611  6137          NZF   CNH             JUMP IF NO SECOND COMMA
2612  0101          PTA
2613  7054          JPI   OUTTYP          OUT LINE ERASED MESSAGE
2614  3766          M6
2615  3776          M7
2616  2077          LDD   TCEXIT
2617  3600          SBC   MARK
2620  1253
2621  6103          NZF   3
2622  7101          JFI   1               ERASE IN DIGIT CALL
2623  1251          MARK  -2
2624  3600          SBC   MARK2 -MARK
2625  0230
2626  6103          NZF   3
2627  7101          JFI   1
2630  1466          INRES                 ERASE IN STUDENT RESPONSE
2631  2100          LDM   STOP            WHERE WAS ERASE CALL
2632  4332
2633  3600          SBC   7620            LC/BLANK
2634  7620
2635  6105          NZF   5
2636  0101          PTA
2637  7055          JPI   BLKBUF
2640  7101          JFI   1
2641  0340          CRA                   ERASE CALL  WAS IN LABEL
2642  3600          SBC   7755            TAB/LC REMAINDER
2643  7755
```

```
2644  6102          NZF   2
2645  7002          JPI   RELAY          ERASE IN FIRST OP CODE LINE
2646  7101          JFI   1
2647  1030                CONT2
2650  0433    CNH   LDN   33
2651  4072          STD   TEMP2
2652  0101          PTA
2653  7046          JPI   PACK
2654  2022          LDD   TEMLTR
2655  7101          JFI   1
2656  2536                CNA
2657  2021    CNG   LDD   CASE
2660  6107          NZF   UC
2661  2200          LDC   CNLC           CONVERT FOR LOWER CASE
2662  3500
2663  5022          RAD   TEMLTR
2664  2122          LDI   TEMLTR
2665  4072          STD   TEMP2
2666  6106          NZF   6
2667  2200    UC    LDC   CNUC
2670  3600
2671  5022          RAD   TEMLTR
2672  2122          LDI   TEMLTR
2673  4072          STD   TEMP2
2674  7077          JPI   TCEXIT
      0077  TCEXIT  EQU   77

                    REM
                    REM
                    REM
2675  0602  Z9Z006 ADN   2              PACKS  PAIRS OF BCD
2676  4016          STD   PKEXIT          CHARAC - INPUT RIGHT
2677  4405          SRD   SWITCH          ADJUSTED SINGLE CHARAC
2700  6311          NJF   LOWER           IN TEMP2
2701  2072          LDD   TEMP2
2702  0111          LS6
2703  4015          STD   TEMPA
2704  2127          LDI   BUFIND
2705  0277          LPN   77             ERASE BCD 20
2706  1415          SCD   TEMPA
2707  4127          STI   BUFIND
2710  7016          JPI   PKEXIT         UPPER HALF EXIT
2711  2127  LOWER   LDI   BUFIND
2712  1200          LPC   7700
2713  7700
2714  1472          SCD   TEMP2
```

```
2715  4127           STI   BUFIND
2716  5427           AOD   BUFIND
2717  7016           JPI   PKEXIT          LOWER EXIT
      0016  PKEXIT   EQU   RE
      0015  TEMPA    EQU   DO

                     REM
                     REM                   MATCH. FINDS MATCH OF INPUT BR OR LA.
                     REM                   IF MATCH, A IS NON ZERO
2720  0602  Z9Z007   ADN   2
2721  4040           STD   RETURN
2722  2200           LDC   STOP    +50D    START OF SYMBOL TABLE
2723  4414
2724  4024           STD   MATCOL          1ST WORD OF EACH ST BLOCK
2725  0505           LCN   5
2726  4200  INDEX    STC
2727  0000
2730  2024           LDD   MATCOL
2731  4070           STD   TEMPO           RUNNING INDEX ON ST
2732  5470           AOD   TEMPO           SKIP FLAG LINE
2733  2026           LDD   BUFCOL
2734  4071           STD   TEMP1           RUNNING INDEX ON TYPEWRITER INPUT
2735  2170           LDI   TEMPO
2736  3571           SBI   TEMP1
2737  6107           NZF   TRYMOR          NO MATCH PAIRS 1-5
2740  5470           AOD   TEMPO
2741  5471           AOD   TEMP1
2742  5713           AOB   INDEX   +1
2743  6506           NZB   6
2744  0401           LDN   1               MADE A MATCH OF ALL 5 PAIRS
2745  6105           NZF   WB
2746  0406  TRYMOR   LDN   6
2747  5024           RAD   MATCOL          SET MATCOL TO BEGINNING OF NEW ST BLOCK
                     REM                   AT FINIS OF SEARCH MATCOL=1ST WRD NEW AREA
2750  3425           SBD   MATIND
2751  6724           NJB   INDEX   -1      MORE ENTRIES LEFT IN TABLE
2752  7040  WB       JPI   RETURN          NO MATCH IN ALL OF TABLE

                     REM
                     REM
                     REM
2753  0602  Z9Z008   ADN   2               INPUTS TYPE CHARAC.
2754  4040           STD   RETURN           STORES IN TEMLTR
2755  7500           EXC   4240
2756  4240
2757  7600           INA
```

```
2760  0220          LPN   20
2761  6504          NZB   Z9Z008 +2       WAITS FOR INP CHAR RDY
2762  7500          EXC   4220
2763  4220
2764  7600          INA
2765  4022          STD   TEMLTR
2766  7040          JPI   RETURN

                    REM
                    REM
                    REM
2767  0602  Z9Z009  ADN   2               OCTAL DECIMAL CONVERSION
2770  4040          STD   RETURN          ENTER WITH TEMPO. RESULTS IN
2771  0400          LDN   0               DESCENDING ORDER IN T1,3,4,5
2772  4071          STD   C1CT
2773  4073          STD   C2CT
2774  4074          STD   C3CT
2775  4075          STD   C4CT
2776  2070          LDD   CT
2777  3600          SBC   1750
3000  1750
3001  6304          NJF   TWO
3002  4070          STD   CT
3003  5471          AOD   C1CT
3004  6506          NZB   Z9Z009 +7
3005  2070  TWO     LDD   CT
3006  3600          SBC   144
3007  0144
3010  6304          NJF   THR
3011  4070          STD   CT
3012  5473          AOD   C2CT
3013  6506          NZB   TWO
3014  2070  THR     LDD   CT
3015  0712          SBN   12
3016  6304          NJF   FOUR
3017  4070          STD   CT
3020  5474          AOD   C3CT
3021  6505          NZB   THR
3022  2070  FOUR    LDD   CT
3023  0701          SBN   1
3024  6304          NJF   EX
3025  4070          STD   CT
3026  5475          AOD   C4CT
3027  6505          NZB   FOUR
3030  7040  EX      JPI   RETURN
      0071  C1CT    EQU   TEMP1
```

```
                0073    C2CT    EQU     TEMP3
                0075    C4CT    EQU     TEMP5
                0074    C3CT    EQU     TEMP4

                                REM
                                REM
                                REM
3031    0602            Z9Z010  ADN     2               DEC BCD CONVERSION INPUT IN T6
3032    4040                    STD     RETURN          OUTPUT IN T2
3033    2076                    LDD     TEMP6
3034    6104                    NZF     4
3035    0412                    LDN     12
3036    4072                    STD     TEMP2
3037    6102                    NZF     EXI
3040    4072                    STD     TEMP2
3041    7040            EXI     JPI     RETURN

                                REM
                                REM
3042    0602            Z9Z012  ADN     2               NUMBER PACK
3043    4017                    STD     NPEXIT
3044    2200                    LDC     2525
3045    2525
3046    4005                    STD     SWITCH          SET PACK SWITCH
3047    0476                    LDN     76
3050    4072                    STD     TEMP2
3051    0101                    PTA
3052    7046                    JPI     PACK            PACKS LOWER CASE CODE
3053    2071                    LDD     TEMP1
3054    4076                    STD     TEMP6
3055    0101                    PTA
3056    7052                    JPI     DECBCD
3057    0101                    PTA
3060    7046                    JPI     PACK
3061    2073                    LDD     TEMP3
3062    4076                    STD     TEMP6
3063    0101                    PTA
3064    7052                    JPI     DECBCD
3065    0101                    PTA
3066    7046                    JPI     PACK
3067    2074                    LDD     TEMP4
3070    4076                    STD     TEMP6
3071    0101                    PTA
3072    7052                    JPI     DECBCD
3073    0101                    PTA
3074    7046                    JPI     PACK
```

```
3075  2075            LDD   TEMP5
3076  4076            STD   TEMP6
3077  0101            PTA
3100  7052            JPI   DECBCD
3101  0101            PTA
3102  7046            JPI   PACK
3103  0455            LDN   55
3104  4072            STD   TEMP2
3105  0101            PTA
3106  7046            JPI   PACK
3107  7017            JPI   NPEXIT
      0017  NPEXIT     EQU   ME

                      REM
                      REM
3110  0602  Z9Z013    ADN   2                 OUTTYP
3111  4040            STD   RETURN
3112  2140            LDI   RETURN
3113  4070            STD   TEMP0
3114  5440            AOD   RETURN
3115  2140            LDI   RETURN
3116  4071            STD   TEMP1
3117  5440            AOD   RETURN
3120  7523  T1        EXF   TYOUT2
3121  2170            LDI   TEMP0
3122  0111            LS6
3123  0277            LPN   77
3124  4072            STD   TEMP2
3125  2170            LDI   TEMP0
3126  0277            LPN   77
3127  4073            STD   TEMP3
3130  7312            OUT   T2
3131  0074                  TEMP4
3132  7512            EXF   TYST2
3133  7600            INA
3134  0240            LPN   40
3135  6503            NZB   3
3136  5470            AOD   TEMP0
3137  3471            SBD   TEMP1
3140  6520            NZB   T1
3141  7040            JPI   RETURN
3142  0072  T2                TEMP2
3143  4210  TYOUT2            4210
3144  4240  TYST2             4240

                      REM
```

```
                        REM
                        REM
3145  0602    Z9Z014    ADN   2                 BLKBUF
3146  4076              STD   TEMP6
3147  2200              LDC   STOP
3150  4332
3151  4075              STD   TEMP5
3152  2200              LDC   2020
3153  2020
3154  4175              STI   TEMP5
3155  5475              AOD   TEMP5
3156  3600              SBC   STOP    +51D
3157  4415
3160  6506              NZB   6
3161  7076              JPI   TEMP6


                        REM

                        REM                     DECOCT
                        REM                     CONVERT BCD DEC TO OCT
                        REM                       12 BIT RESULT IN TEMPO
3162  0602    Z9Z015    ADN   2
3163  4040              STD   RETURN
3164  2140              LDI   RETURN
3165  4202              STF   2
3166  2100              LDM
3167  0000
3170  4076              STD   TEMP6
3171  5440              AOD   RETURN
3172  2140              LDI   RETURN
3173  4202              STF   2
3174  2100              LDM
3175  0000
3176  4077              STD   TEMP7
3177  5440              AOD   RETURN
3200  2076              LDD   TEMP6           FIRST TWO INPUT CHARAC
3201  0111              LS6
3202  0277              LPN   77
3203  4071              STD   CT1             FIRST CHARAC
3204  2076              LDD   TEMP6
3205  0277              LPN   77
3206  4072              STD   CT2             SECOND CHARAC
3207  2077              LDD   TEMP7           LAST PAIR OF BCD CHARAC
3210  0111              LS6
3211  0277              LPN   77
```

```
3212  4073          STD   CT3          THIRD CHARAC
3213  2077          LDD   TEMP7
3214  0277          LPN   77
3215  4074          STD   CT4          FOURTH CHARAC
3216  0400          LDN   0
3217  4070          STD   CT
3220  2071          LDD   CT1
3221  0712          SBN   12
3222  6007          ZJF   7
3223  2200          LDC   1750
3224  1750
3225  5070          RAD   CT
3226  0501          LCN   1
3227  5071          RAD   CT1
3230  6505          NZB   5
3231  2072          LDD   CT2
3232  0712          SBN   12
3233  6007          ZJF   7
3234  2200          LDC   144
3235  01 4
3236  50 0          RAD   CT
3237  0501          LCN   1
3240  5072          RAD   CT2
3241  6505          NZB   5
3242  2073          LDD   CT3
3243  0712          SBN   12
3244  6006          ZJF   6
3245  0412          LDN   12
3246  5070          RAD   CT
3247  0501          LCN   1
3250  5073          RAD   CT3
3251  6504          NZB   4
3252  2074          LDD   CT4
3253  0712          SBN   12
3254  6003          ZJF   3
3255  2074          LDD   CT4
3256  5070          RAD   CT
3257  7040          JPI   RETURN
      0070    CT    EQU   TEMP0
      0071    CT1   EQU   TEMP1
      0072    CT2   EQU   TEMP2
      0073    CT3   EQU   TEMP3
      0074    CT4   EQU   TEMP4
                    REM
                    REM
                    REM
```

```
3260  0602    Z9Z016  ADN   2              TYCON
3261  4077            STD   TEMP7
3262  2004            LDD   ON/OFF
3263  4005            STD   SWITCH
3264  0400            LDN   0
3265  4021            STD   CASE
3266  4014            STD   EOBFLG
3267  2200            LDC   OUTBUF
3270  4250
3271  4006            STD   OUTIND
3272  4405    CONVER  SRD   SWITCH
3273  6222            PJF   UPPER
3274  2127            LDI   BUFIND
3275  0277            LPN   77
3276  4070            STD   TEMP0
3277  0101            PTA
3300  7044            JPI   BCDTYP
3301  4072            STD   TEMP2
3302  0745            SBN   45
3303  6007            ZJF   CR
3304  2071            LDD   TEMP1            HIGH ORDER 6 BITS
3305  5072            RAD   TEMP2
3306  4106            STI   OUTIND
3307  5406            AOD   OUTIND
3310  5427            AOD   BUFIND
3311  6517            NZB   CONVER
3312  2072    CR      LDD   TEMP2
3313  5071            RAD   TEMP1
3314  6116            NZF   CRUP
3315  2127    UPPER   LDI   BUFIND
3316  0111            LS6
3317  0277            LPN   77
3320  4070            STD   TEMP0
3321  0101            PTA
3322  7044            JPI   BCDTYP
3323  0111            LS6
3324  4071            STD   TEMP1
3325  3600            SBC   4500
3326  4500
3327  6535            NZB   CONVER
3330  2200            LDC   445
3331  0445
3332  4106    CRUP    STI   OUTIND
3333  5406            AOD   OUTIND
3334  4204            STF   4
3335  0101            PTA
```

```
3336  7054          JPI   OUTTYP
3337  4250                OUTBUF
3340  0006                OUTIND
3341  7077          JPI   TEMP7


                    REM
                    REM
                    REM                       TAB/LC
3342  0602  Z9Z017 ADN   2
3343  4040          STD   RETURN
3344  7504          EXF   TYOUT5
3345  7451          OTN   51
3346  7457          OTN   57
3347  7040          JPI   RETURN
3350  4210  TYOUT5       4210


                    REM
                    REM
                    REM                       RESPONSE COMPARE
3351  0602  Z9Z018 ADN   2
3352  4040          STD   RETURN
3353  2004          LDD   ON/OFF
3354  4005          STD   SWITCH
3355  4070          STD   TEMP0
3356  0400          LDN   0
3357  4014          STD   EOBFLG
3360  4405  RC1     SRD   SWITCH              PROCESS FURNISHED ANSWER
3361  6312          NJF   LOW1
3362  2174          LDI   TEMP4
3363  0111          LS6
3364  0277          LPN   77
3365  4076          STD   TEMP6
3366  0736          SBN   36
3367  6114          NZF   RC4
3370  0401          LDN   1
3371  4014          STD   EOBFLG
3372  6111          NZF   RC4
3373  2174  LOW1    LDI   TEMP4
3374  0277          LPN   77
3375  4076          STD   TEMP6
3376  0736          SBN   36                  EOB CHECK
3377  6103          NZF   RC4     -1
3400  0401          LDN   1
3401  4014          STD   EOBFLG
```

```
3402  5474          AOD   TEMP4
3403  4470   RC4    SRD   TEMP0          PROCESS STUDENT RESPONSE
3404  6310          NJF   LOW
3405  2173          LDI   TEMP3
3406  0111          LS6
3407  0277          LPN   77
3410  4075          STD   TEMP5
3411  0720          SBN   20
3412  6407          ZJB   RC4
3413  6111          NZF   RC
3414  2173   LOW    LDI   TEMP3
3415  0277          LPN   77
3416  4075          STD   TEMP5
3417  0720          SBN   20
3420  6103          NZF   3
3421  5473          AOD   TEMP3          SQUEEZE OUT SPACE
3422  6517          NZB   RC4
3423  5473          AOD   TEMP3
3424  2075   RC     LDD   TEMP5          MATCHING ROUTINE
3425  0736          SBN   36             EOB
3426  6104          NZF   4              CONTINUE MATCH UNTIL EOB REACHED IN
3427  2014          LDD   EOBFLG                 SUPPLIED ANSWER
3430  6107          NZF   7              MATCH IF EOB SAME PLACE IN ANS AND
3431  6004          ZJF   4               ALL CHARAC MATCH PREVIOUS
3432  2075          LDD   TEMP5
3433  3476          SBD   TEMP6
3434  6454          ZJB   RC1
3435  0400          LDN   0              NO MATCH
3436  7040          JPI   RETURN
3437  0401          LDN   1
3440  7040          JPI   RETURN

                    REM
                    REM
                    REM                  CRSERR
3441  4206   Z9Z019 STF   6
3442  0101          PTA
3443  7054          JPI   OUTTYP
3444  4070                MC5
3445  4115                MC6
3446  2200          LDC
3447  0000
3450  7700          HLT

                    REM
```

```
                        REM                         ADVLNE
3451  0602    Z9Z020    ADN     2
3452  4040              STD     RETURN
3453  0462              LDN     50D
3454  5007              RAD     TYPBUF
3455  4027              STD     BUFIND
3456  3411              SBD     LASENT              CHECK FOR END OF COURSE BLOCK
3457  6102              NZF     2
3460  7003              JPI     RELAY2
3461  7040              JPI     RETURN

      3500              PRG     3500                MUST BE A MULTIPLE OF 100                  *********
3500  0000    CNLC      BSS     1                                       NOT YET USED
3501  0023              BCDR    7                   T=0 HNM
3502  0013
3503  0046
3504  0020
3505  0070
3506  0045
3507  0044
3510  0000              BSS     1                                       NOT YET USED
3511  0043              BCDR    24D                 LRGIPCVEZDBSYFXAWJ8UQK9,
3512  0051
3513  0067
3514  0071
3515  0047
3516  0063
3517  0025
3520  0065
3521  0031
3522  0064
3523  0062
3524  0022
3525  0030
3526  0066
3527  0027
3530  0061
3531  0026
3532  0041
3533  0010
3534  0024
3535  0050
3536  0042
3537  0011
3540  0033
3541  0000              BSS     1                                       NOT YET USED
```

```
3542  0073                    73          .
3543  0000          BSS       1                                   NOT YET USED
3544  0021                    21          /
3545  0055                    55          CR
3546  0060                    60          +
3547  0016                    16          UC
3550  0053                    53          SEMICOLON APOS
3551  0075                    75          TAB
3552  0040                    40          -
3553  0000          BSS       1                                   NOT YET USED
3554  0053                    53          APOS
3555  0000          BSS       1                                   NOT YET USED
3556  0012                    12          0           (
3557  0076                    76          LC
3560  0007                    7           7
3561  0056                    56          BKSPCE
3562  0004                    4           4
3563  0000          BSS       1                                   NOT YET USED
3564  0003                    3           3
3565  0000          BSS       1                                   NOT YET USED
3566  0005                    5           5
3567  0000          BSS       1                                   NOT YET USED
3570  0002                    2           2
3571  0000          BSS       1                                   NOT YET USED
3572  0006                    6           6
3573  0000          BSS       1                                   NOT YET USED
3574  0001                    1           1
3575  0000          BSS       1                                   NOT YET USED
3576  0000          BSS       1                                   NOT YET USED
3577  0000          BSS       1                                   NOT YET USED
3600  0000    CNUC  BSS       1                                   NOT YET USED
3601  0023                    23          T           SUP B
3602  0013                    13                      SUP 1
3603  0046          BCDR      5           0 HNM
3604  0020
3605  0070
3606  0045
3607  0044
3610  0000          BSS       1                                   NOT YET USED
3611  0043          BCDR      18D         LRGIPCVEZDBSYFXAWJ
3612  0051
3613  0067
3614  0071
3615  0047
3616  0063
3617  0025
```

```
3620  0065
3621  0031
3622  0064
3623  0062
3624  0022
3625  0030
3626  0066
3627  0027
3630  0061
3631  0026
3632  0041
3633  0000          BSS   1              1/2          SUP 8
3634  0024          BCDR  5              UQK(,
3635  0050
3636  0042
3637  0034
3640  0033
3641  0000          BSS   1                                  NOT YET USED
3642  0073                73             .            .
3643  0000          BSS   1                                  NOT YET USED
3644  0021                21             QUES MRK     SAME
3645  0055                55             CR           SAME
3646  0000          BSS   1                                  NOT YET USED
3647  0016                16             UC           SAME
3650  0053                53             COLON        SUB2
3651  0075                75             TAB          SAME
3652  0040                40             -
3653  0000          BSS   1                                  NOT YET USED
3654  0072                72             QUOTES
3655  0000          BSS   1                                  NOT YET USED
3656  0074                74             )
3657  0076                76             LC
3660  0007                7              AND SIGN
3661  0056                56             BKSPACE
3662  0053                53             $
3663  0000          BSS   1                                  NOT YET USED
3664  0000          BSS   1              LB. SIGN            NOT YET USED
3665  0000          BSS   1                                  NOT YET USED
3666  0000          BSS   1              PERCENT             NOT YET USED
3667  0000          BSS   1                                  NOT YET USED
3670  0000          BSS   1              AT SIGN             NOT YET USED
3671  0000          BSS   1                                  NOT YET USED
3672  0000          BSS   1              CENT SIGN           NOT YET USED
3673  0000          BSS   1                                  NOT YET USED
3674  0054                54             *
3675  0000          BSS   1                                  NOT YET USED
```

```
3676  0000          BSS   1                          NOT YET USED
3677  0000          BSS   1                          NOT YET USED
3700  4547  M1            4547        CR/UC
3701  2012          FLX   29D         ERROR IN OP CODE.  TRY AGAIN.
3702  1203
3703  1204
3704  1406
3705  0403
3706  1504
3707  1603
3710  2220
3711  4204
3712  0401
3713  1225
3714  0430
3715  1330
3716  1406
3717  4204
3720  4547  M3            4547        CR/UC
3721  2234          FLX   16D         DUPLICATE LABEL.
3722  1511
3723  1416
3724  3001
3725  2004
3726  1130
3727  2320
3730  1142
3731  4547  M4            4547        CR/UC
3732  0603          FLX   26D         NO CR BEFORE EOB-TRY AGAIN
3733  0416
3734  1204
3735  2320
3736  2603
3737  1220
3740  0420
3741  0323
3742  5201
3743  1225
3744  0430
3745  1330
3746  1406
3747  4547  M5            4547        CR/UC
3750  2503          FLX   26D         YOUR LAST COURSE RECORD IS
3751  3412
3752  0411
3753  3024
```

```
3754  0104
3755  1603
3756  3412
3757  2420
3760  0412
3761  2016
3762  0312
3763  2204
3764  1424
3765  5045                    5045          SEMICOLON/CR
3766  4547   M6               4547          CR/UC
3767  1157                    1157          L/LC
3770  1406         FLX        10D           INE ERASED
3771  2004
3772  2012
3773  3024
3774  2022
3775  4245                    4245          ./CR
3776  4547   M7               4547          CR/UC
3777  0125         FLX        27D           TYPE O FOR OLD OR N FOR NEW
4000  1520
4001  0403
4002  0426
4003  0312
4004  0403
4005  1122
4006  0403
4007  1204
4010  0604
4011  2603
4012  1204
4013  0620
4014  3104
4015  4557                    4557
4016  4547   MC1              4547          CR/UC
4017  0125         FLX        14D           TYPE LAST NAME
4020  1520
4021  0411
4022  3024
4023  0104
4024  0630
4025  0720
4026  4557                    4557          CR/LC
4027  4547   MC2              4547          CR/UC
4030  0125         FLX        12D           TYPE DESIRED
4031  1520
```

```
4032  0422
4033  2024
4034  1412
4035  2022
4036  0457                    457
4037  6247                    6247          4  UC
4040  0422          FLX       19D            DIGIT START NUMBER
4041  1413
4042  1401
4043  0424
4044  0130
4045  1201
4046  0406
4047  3407
4050  2320
4051  1204
4052  4557                    4557          CR/LC
4053  4547          MC4       4547          CR/UC
4054  0105          FLX       21D           THE CORRECT ANSWER IS
4055  2004
4056  1603
4057  1212
4060  2016
4061  0104
4062  3006
4063  2431
4064  2012
4065  0414
4066  2404
4067  4557                    4557          CR/LC
4070  4547          MC5       4547          CR/UC
4071  1603          FLX       14D           COURSE ERROR.
4072  3412
4073  2420
4074  0420
4075  1212
4076  0312
4077  4204
4100  0414          MC5.1     FLX   23D      INSTRUCTION TERMINATED.
4101  0624
4102  0112
4103  3416
4104  0114
4105  0306
4106  0401
4107  2012
```

```
4110  0714
4111  0630
4112  0120
4113  2204
4114  4557                        4557          CR/LC
4115  4547    MC6                 4547          CR/UC
4116  0125            FLX         32D           TYPE S FOR STUDENT OR P FOR PROF
4117  1520
4120  0424
4121  0426
4122  0312
4123  0424
4124  0134
4125  2220
4126  0601
4127  0403
4130  1204
4131  1504
4132  2603
4133  1204
4134  1512
4135  0326
4136  4245                        4245
4137  5700                        5700
4140  4547    MC7                 4547
4141  2003            FLX         16D           EOC OR UNAV. LAB
4142  1604
4143  0312
4144  0434
4145  0630
4146  1742
4147  0411
4150  3023
4151  0045    MC8                 45            CR
4152  0051    MC9                 51            TAB
4153  0047    MC10                47            UC
4154  0050    MC11                50            COLON
4155  0057    MC12                57            LC
4156  0004    MC13                4             SPACE
4157  0004    MC14                4
4160  0000    MC15

4161  0000    NAMBUF  BSS         10D
4173  0000    NUMBUF  BSS         5
4200  0000    RESBUF  BSS         40D
4250  0000    OUTBUF  BSS         50D
```

```
4332  0000    STOP
      4332    CRSBUF EQU   STOP

      0000           END
```

This listing was generated using the OSAS system which is a two pass assembler written for use with the CDC 160 computer. The CDC 405 card reader was used for symbolic input and the CDC 1607 magnetic tape units were used for intermediate input/ output, listable output and binary output.

APPENDIX VI

DEFINITIONS OF SIGNIFICANT SYMBOLIC TERMS

Symbol	Definition or description
OUTIND	Index for the typewriter output buffer.
TYPBUF	Temporary storage for the first word of each line.
LASENT	Last word address of storage used by the course block in the computer.
LANUM	Last current reference number of the symbol table.
GOTO	Temporary storage for the argument of the GOTO request.
EOBFLG	A "1" indicates an EOB code has been encountered in the conversion routine.
CASE	A "1" flags upper case.
TEMLTR	Temporary storage for the most recent input typewriter character.
NAMBUF	Index for student name buffer area.
NATCOL	Variable index used in a symbol table search.
MATIND	Indicates the last word address of the current symbol table.
BUFCOL	Start of course storage area.
BUFIND	Index used for proceeding through course material.
OLD	Start of routine that searches tape for the beginning of the symbol table.
RST	Read symbol table.
START	Beginning of instructor input program.
CRA	Routine to analyze the contents of the label field.
LALIM	Label field character limit.

LAIN	Actual start of label field cracking.
MATCH	Seeks match for entry in label field.
NOMAT (NOMAT1)	Entry point when no match has been found for the label (branch).
STDUMP	Symbol table dump to tape routine.
NCR	Routine to analyze op code field.
NORMOP	Normal op code has been used.
NXLN	Next line.
BRNOP	Branch op code was used.
BRLIM	Branch argument character limit.
BRIN	Branch analysis routine.
STUDNT	Entry to student mode.
START2	Re-entry to student mode once established therein.
INRES	Input student response.
RIGHT(RIGHT1)	Entry point for a ca/cb (wa/wb) successful execution.
WRONG(WRONG1)	Entry point for an unsuccessful ca/cb (wa/wb) execution.
UN	Process UN argument.
BR	Process BR argument. Also entered at BR + 13 for GOTO statements.
BCDOCT (Z9Z001)	Special BCD to octal conversion for the number of words in the label-branch symbol table. Entered with two BCD numbers in TEMPO. Leaves $00XX_8$ in A.
TASTAT (Z9Z002)	Checks tape status. If the tape unit is ready the contents of A will be zero.

TAPE (Z9Z003)

This is the generalized magnetic tape read/write routine. When the routine senses a parity error, three reads or writes will be attempted followed by an error halt.

Calling sequence:

```
p       PTA
p+1     JP1  TAPE
p+2          first word address
p+3          last word address + 1
p+4          address desired for
             return.  Status left in A.
```

BCDTYP (Z9Z004)

Converts 6-bit BCD to 6-bit type code. Input in TEMP0. Output in A.

TYPINP (Z9Z005)

Converts input type code to BCD. Uses TYPIN as a subroutine. Recognizes the double codes".." and ",,". Input in TEMLTR. Output in TEMP2.

PACK (Z9Z006)

Packs two BCD characters into one computer word. Contains an internal switch to determine if character should go in upper or lower location. Input is right adjusted BCD character in TEMP2. Output is stored indirectly as determined by BUFIND which must be set before entry to PACK.

MATCH1 (Z9Z007)

Searches symbol table for a match to the symbol just generated. The storage index for the new symbol is BUFCOL. MATCOL is the variable index for the symbol table and MATIND holds the last address of the symbol table. If a match is found, (A) is non-zero.

TYPIN (Z9Z008) Input routine for the typewriter code. Stores character in TEMLTR.

OCTDEC (Z9Z009) Octal-decimal conversion routine. Input in TEMP0. Result by digits of descending order in TEMP1, TEMP3, TEMP4 and TEMP5.

DECBCD (Z9Z010) Decimal to BCD conversion. Input in TEMP6. Output in TEMP2.

NUMPK (Z9Z012) Adds symbol table reference number to line containing label or branch. Calls PACK and DECBCD. The input digits are located in TEMP1, TEMP3, TEMP4 and TEMP5. The routine also adds a carriage return code at the end of the line.

OUTTYP (Z9Z013) This is the generalized typewriter output routine. The calling sequence is as follows:

```
p       PTA
p+1     JP1  OUTTYP
p+2          first word address
p+3          last word address + 1
p+4          normal return
```

BLKBUF (Z9Z014) Sets the buffer area to BCD blanks.

DECOCT (Z9Z015) BCD decimal to octal conversion. First pair of BCD character in TEMP6. Last pair in TEMP7. 12-bit result in TEMP0.

TYCON (Z9Z016) — Executive control routine for the typewriter output. Calls BCDTYP for conversion and establishes an output buffer via the index OUTIND. The input buffer is indexed by BUFIND. This routine also sets up the first and last word addresses for OUTTYP.

TAB/LC (Z9Z017) — Outputs tab and lower case shift to the typewriter.

RESCOM (Z9Z018) — This routine compares the student response to the author supplied answers character by character. Spaces are ignored. The routine stops when an EOB code is encountered. Contents of A are non-zero when a match has been made.

CRSERR (Z9Z019) — This routine sets up OUTTYP for a course error message.

ADVLNE (Z9Z020) — This routine steps the index TYPBUF by increments of 50 ---the number of storage words required to hold 100 packed characters. It also sets the initial value of BUFIND.

TA_____ — All symbolic codes with this prefix refer to the tape unit.

TY_____ — All symbolic codes with this prefix refer to the typewriter.

APPENDIX VII

SYMBOLIC REFERENCE TABLE

OSAS SYMBOLIC REFERENCE TABLE 260 SYMBOLS

1641	ACONT	1553	1573	1624	1631	1754	2007	2132					
1704	ADCHK	1671											
2051	ADCHK1	2036											
2405	ADDR	2365	2370	2371	2372	2430							
0063	ADVLNE	1370	1404	1437	1654	1700	1715	1740	2026	2045	2072	2152	2162
1544	A1	1530											
1564	A2	1535	1546										
1622	A3	1566											
2277	BACKW	2256											
0041	BCDOCT	0214	0222	0233	0240								
0044	BCDTYP	3300	3322										
0131	BEGIN	0120	0125	0432	2316								
0311	BKSP2	0254	0260	0304									
2442	BKSP.	2422											
0055	BLKBUF	0327	1034	2637									
2247	BOEOF	2223	2227										
2321	BOVEOF	2274											
2204	BR	1460	1713	2060	2176								
1111	BRIN	1076	1103										
1066	BRLIM	1101	1102										
1050	BRNOP	0762											
2217	BRX	1563											
0026	BUFCOL	0473	0524	1113	1121	1142	1171	2733					
0027	BUFIND	0315	0342	0475	0700	0730	0731	1000	1032	1050	1144	1241	1344
		1371	1372	1400	1417	1420	1433	1440	1444	1445	1474	1615	1655
		1660	1661	1674	1716	1741	1744	1745	1751	2004	2012	2027	2032
		2033	2041	2073	2076	2077	2127	2135	2136	2142	2144	2163	2166
		2167	2704	2707	2711	2715	2716	3274	3310	3315	3455		
0021	CASE	0331	1243	1500	2452	2466	2471	2541	2551	2657	3265		
2471	CHARAC	2464											
0433	CHKSTU	0414											
2536	CNA	2602	2656										
2545	CNB	2537											
2555	CNC	2547											
2563	CND	2557											
2603	CNE	2565											
2575	CNF	2571											
2657	CNG	2605											
2650	CNH	2611											
3500	CNLC	2473	2661										
0031	CNTR1	1301	1561	2205	2255	2277							
0032	CNTR2												

0033	CNTR3										
0034	CNTR4										
0035	CNTR5										
0036	CNTR6										
0037	CNTR7										
3600	CNUC	2506	2512	2667							
0302	CONT	0301									
1030	CONT2	1027	2647								
0313	CONT3	0303									
3272	CONVER	3311	3327								
0020	CON1	0145	0167								
3312	CR	3303									
0340	CRA	0335	2641								
0062	CRSERR	1352	1430	1465	2011	2134	2203				
3332	CRUP	3314									
2213	DCALL	2210	2211	2212							
0052	DECBCD	0574	0605	0616	0626	3056	3064	3072	3100		
0056	DECOCT	1263	1362	1555	2214	2261					
1233	DIGIT	0446	1261	1267							
0015	DO										
2455	EOB	2450									
0014	EOBFLG	1405	1442	1701	2046	2153	2460	3266	3357	3371	3401	3427
1036	EOB1	1017									
0010	EOC										
1337	EOF	1322									
2305	ERROR	1331	2257								
3030	EX	3024									
3041	EXI	3037									
2431	EXIT	2412	2416								
0100	FIRST	1543									
2274	FOUND	2266	2304								
3022	FOUR	3016	3027								
0663	FWA	0656									
2243	FWA1	2250									
1314	FWA3	1306	1323	1333							
2437	FWA.	2371	2375								
1660	GOAGN	1702	1703								
2032	GOAGN1	2047	2050								
0013	GOTO	1270	2220	2264							
2223	HERE										
1321	INAGAN	1316									
2726	INDEX	2742	2751								
1466	INRES	1463	1510	1621	2160	2630					

2160	JUMP	2070											
0401	LAIN	0366	0373										
0356	LALIM	0371	0372										
0012	LANUM	0166	0242	0510	0515	0561	0644	1155	1162	1366	2221		
0011	LASENT	1340	3456										
2463	LC2	2456											
3414	LOW	3404											
2711	LOWER	2700											
3373	LOW1	3361											
0664	LWA	0657											
2244	LWA1												
1315	LWA3	1310	1335	1337									
2406	LWA.	2400											
1253	MARK	2617	2623	2624									
1503	MARK2	2624											
0450	MATCH	0407	0421	0426	0435	0442							
0047	MATCH1	0451	1115										
0024	MATCOL	0454	0465	1125	1130	1134	1165	2724	2730	2747			
0025	MATIND	0170	0227	0520	0526	0530	0532	0534	1174	1176	1200	1202	2750
4016	MC1	0156	1216										
4153	MC10												
4154	MC11												
4155	MC12	1470											
4156	MC13	0325	1003	1053	1471								
4157	MC14	1004											
4160	MC15	1054											
4027	MC2	1217	1235										
4053	MC4	1236	1611										
4070	MC5	1612	3444										
4100	MC5.1	1540	2313										
4115	MC6	0133	1541	2314	3445								
4140	MC7	0134	2307										
4151	MC8	0324	1355	1415	1520	2310							
4152	MC9	1356	1416	1521									
0017	ME	1441	2066	2155									
1400	MORE	1406	1426	1731									
3700	M1	0775	2525										
3720	M3	0460	0776										
3731	M4	0376	0461	1106									
3747	M5	0267	0377	1107									
3766	M6	0270	2614										
3776	M7	0155	2615										

0023	NAMBF	1213	1227	1230									
4161	NAMBUF	1211											
0676	NCR	0337											
0510	NOMAT	0453											
1155	NOMAT1	1124											
1000	NORMOP	0734	0737	0742	0744	0747	0752	0755	0760	0765	0767	0772	
4173	NUMBUF	0547	0551	0555	0641	0652	0653						
0053	NUMPK	0477	1146										
1765	NX	1762											
1011	NXLN	1021	1035										
0051	OCTDEC	0472	1141										
2250	OK1	2245											
0172	OLD	0162	0175	0210	1640								
0004	ON/OFF	0343	0701	1244	1475	3262	3353						
0030	OPLINE	1656	1717	1742	2030	2074	2164						
4250	OUTBUF	3267	3337										
0006	OUTIND	3271	3306	3307	3332	3333	3340						
0054	OUTTYP	0132	0154	0266	0323	0375	0457	0774	1002	1052	1105	1215	1234
		1354	1414	1467	1517	1537	1610	2306	2312	2613	3336	3443	
0046	PACK	0350	0354	0363	0706	0712	0722	0726	1010	1014	1041	1060	1064
		1073	1254	1512	1515	2600	2653	3052	3060	3066	3074	3102	3106
2443	PARSW	2417	2434										
0145	PROF	0140											
1433	QU	1375	1423	1443	1450	1736							
3424	RC	3413											
0271	RCRS	0321											
3360	RC1	3434											
3403	RC4	3367	3372	3377	3412	3422							
2440	RDORWR	2362	2404	2431	2435								
0016	RE												
0002	RELAY	0171	0400	0462	0777	1110	2645						
0003	RELAY2	2237	2276	3460									
1640	RELY	1636											
4200	RESBUF	1472	1522	1556	1557	1644	2014						
0061	RESCOM	1651	2021										
0666	RESU	0665											
0655	RESUM	0654											
2531	RETCH	2454	2462	2470	2504	2523							
0040	RETURN	2323	2347	2360	2361	2373	2374	2376	2377	2401	2402	2403	2436
		2445	2531	2721	2752	2754	2766	2770	3030	3032	3041	3111	3112
		3114	3115	3117	3141	3163	3164	3171	3172	3177	3257	3343	3347
		3352	3436	3440	3452	3461							

2320	REWIN	2300										
0130	REWND	0121										
1637	REWND1	1632										
1653	RIGHT	1664	1666									
2025	RIGHT1	2022	2065									
2317	ROVEF	2267										
2246	ROVREF	2233										
0243	RST	0245										
0204	SEOF	0172										
0312	SEOF1	0264										
1320	SEOF2	1271										
0251	S	0224										
0205	STAOK	0203										
0254	STAOK1	0253										
0322	START	0002	0310	0507	1047	1154						
1304	START2	0003	1336									
0541	STDUMP	0447										
4332	STOP	0020	0026	0251	0277	0300	0313	0340	0401	0505	0506	0663	0676
		1025	1026	1030	1045	1046	1111	1117	1152	1153	1237	1264	1265
		2631	2722	3147	3156								
1211	STUDNT	0144											
0005	SWITCH	0344	07C2	1245	1476	2677	3046	3263	3272	3354	3360		
0447	SYM	0430	0444										
0060	T B/LC	1377	1432	1673	2040	2146							
0043	TAPE	0177	0247	0275	0503	0650	0661	1023	1043	1150	1312	2241	
2240	TASRCH	1303	2222	2273									
0042	TASTAT	0123	0174	0244	0256	0262	0272	0306	0673	1634	2225	2231	2235
		2271	2302										
0127	TAST5	0104											
1317	TAST7	1272											
2441	TAST.	2407	2424										
0022	TEMLTR	0716	2331	2337	2346	2545	2555	2563	2601	2603	2654	2663	2664
		2671	2672	2765									
0070	TEMP0	0106	0112	0116	0146	0150	0151	0201	0205	0212	0220	0231	0236
		0403	0404	0410	0411	0415	0416	0422	0423	0436	0437	0470	0525
		0531	0533	1116	1122	1137	1173	1177	1201	1266	1365	1524	1525
		1531	1532	1547	1550	1567	1570	1625	1626	2217	2265	2324	2333
		2340	2344	2446	2500	2517	2731	2732	2735	2740	3113	3121	3125
		3136	3276	3320	3355	3403							
0071	TEMP1	0211	0216	0223	0225	0527	0537	1175	1207	2734	2736	2741	3053
		3116	3137	3304	3313	3324							
0072	TEMP2	0217	0346	0352	0364	0704	0710	1006	1015	1037	1056	1062	1074
		1257	2543	2553	2561	2573	2576	2651	2665	2673	2701	2714	3036
		3040	3050	3104	3124	3142	3301	3305	3312				

0073	TEMP3	0230	0234	0241	0562	0563	0565	1642	1643	1647	1752	2005	2013
		2017	2130	3061	3127	3405	3414	3421	3423				
0074	TEMP4	0235	0564	0566	0600	0610	0622	0645	1646	2016	3067	3131	3362
		3373	3402										
0075	TEMP5	0202	0567	0655	2351	2356	3075	3151	3154	3155	3410	3416	3424
		3432											
0076	TEMP6	0572	0603	0614	0624	3033	3054	3062	3070	3076	3146	3161	3170
		3200	3204	3365	3375	3433							
0077	TEMP7	0542	0675	1576	1577	1600	1605	1613	1614	3176	3207	3213	3261
		3341											
0252	TERM	0226											
3014	THR	3010	3021										
2746	TRYMOR	2737											
3005	TWO	3001	3013										
0057	TYCON	0317	1360	1402	1435	1617	1676	2043	2150				
3143	TYOUT2	3120											
3350	TYOUT5	3344											
0007	TYPBUF	1343	1345	1641	2067	2156	2206	3454					
0050	TYPIN	0136	0160	0333	2535	2567	2607						
0045	TYPINP	0361	0724	1012	1071	1224	1252	1410	1502				
0126	TYST1	0100											
3144	TYST2	3132											
3120	T1	3140											
3142	T2	3130											
2667	UC	2660											
2135	UN	1764	2107	2154	2172	2201							
2512	UPC2	2472											
3315	UPPER	3273											
2161	USED	2141	2165										
2012	WA	1757	2102	2104									
2752	WB	2745											
1737	WRONG	1652	1773	1775	2000								
2071	WRONG1	2024	2116	2120	2123								
1135	X1	1131	1210										
0466	X5	0540											
0576	Z1	0553	0632										
0606	Z2	0554	0634										
0620	Z3	0557	0636										
0627	Z4	0560	0640										
0570	Z5	0646											
2322	Z9Z001	0041											
2350	Z9Z002	0042											
2357	Z9Z003	0043											

2444	Z9Z004	0044	
2532	Z9Z005	0045	0720
2675	Z9Z006	0046	
2720	Z9Z007	0047	
2753	Z9Z008	0050	2761
2767	Z9Z009	0051	3004
3031	Z9Z010	0052	
3042	Z9Z012	0053	
3110	Z9Z013	0054	
3145	Z9Z014	0055	
3162	Z9Z015	0056	
3260	Z9Z016	0057	
3342	Z9Z017	0060	
3351	Z9Z018	0061	
3441	Z9Z019	0062	
3451	Z9Z020	0063	